Vol. 19, No. 8
August 1994

Energy Research Abstracts

Abstracts 20608–23342

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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UNITED STATES DEPARTMENT OF ENERGY
Office of Scientific and Technical Information
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Vol. 19, No. 8
August 1994
ISSN: 0160-3604
CODEN: ERABDZ

Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 16-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors can obtain *ERA* (regular issues and annual indexes) by using VISA, MasterCard, or OSTI deposit accounts. Contact the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Milton O. Whitson

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

Canada	Poland
Denmark	Republic of Korea
Finland	Spain
France	Sweden
Germany	Switzerland
Italy	The Netherlands
Japan	United Kingdom
Norway	United States

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In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

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The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in 30m^2 air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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Government Printing Office
Washington, DC 20402

GPO Dep. Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.

INIS *Available only in microfiche.*
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

NTIS U.S. Department of Commerce
Technology Administration
National Technical Information Service
Springfield, VA 22161

OSTI U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

ESTSC Energy Science and Technology Software Center
P.O. Box 1020
Oak Ridge, TN 37831-1020

CASI Attention: Document Order
NASA Center for AeroSpace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–T1	15:18494	NTIS, OSTI	E 1.99: DE89007246	MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 38 first-level and the 313 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB--1-R2, *International Energy: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

0103 Preparation

Refer also to citation(s) 20666, 20730, 21285

20608 (DOE/MC/10637–3663, pp. Paper 11, 40) **Beneficiation of low-rank coals.** Potas, T.A. (Univ. of North Dakota, Grand Forks, ND (United States)); Timpe, R.C.; DeWall, R.A.; Musich, M.A.; Anderson, C.M.; Erjavec, J. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The overall objectives of the Low-Rank Coal Beneficiation project were to study methods of reducing the inorganic content and increasing the heating value of low-rank coal (LRC) to produce high-quality dry coal products and/or coal/water fuels (CWF). The University of North Dakota Energy & Environmental Research Center (EERC) has demonstrated that high-energy content dry of slurry fuels can be produced from lignite and subbituminous coal using the hot-water drying process (HWD) and that low-ash, coal-based fuel can be produced using a combination of physical and chemical cleaning processes. These processes were integrated to achieve a greater than 400 lb/hr pilot-scale throughput for producing clean, energy-dense coal and/or CWF from low cost, highly reactive LRC feedstocks. These pilot-scale capabilities continue to supply fuels to DOE-sponsored Combustion, Gasification, and Heat Engine programs running concurrently with the Low-Rank Coal Beneficiation Program.

20609 (DOE/MT/92019–1) **Effect of coal beneficiation process on rheology/atomization of coal water slurries: Quarterly progress report, October 1, 1992–December 31, 1992.** Ohene, F. Grambling State Univ., LA (United States). Dept. of Chemistry. [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92MT92019. Order Number DE94013950. Source: OSTI; NTIS; GPO Dep.

Three different coal water slurry samples were received from Amax R&D. The samples were prepared from Upper Elkhorn No. 3 (Taggart). The properties of the slurries are as shown in the appendix. The samples supplied were ~20 mesh-size samples, wet ground uncleaned slurry (99% passing through 48 mesh), wet ground heavy-media cleaned slurry (99% passing through 48 mesh), and wet ground froth flotation cleaned slurry (99% passing through 48 mesh). Also, a portion of the ~20 mesh samples were dry ground to produce ~48 mesh samples. FTIR analysis were performed on these samples in order to elucidate any differences in the functional groups due to the preparation of the CWS samples.

20610 (DOE/PC/91283–T12) **Floatabilities of treated coal in water at room temperature: Annual topical report, September 1992–August 1993.** Kwon, K.C. (Tuskegee Univ., AL (United States). Dept. of Chemical Engineering); Rohrer, R.L.; Lai, R.W.; Finseth, D.H. Tuskegee Univ., AL (United States). Dept. of Chemical Engineering. [1993]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91283. Order Number DE94011776. Source: OSTI; NTIS; GPO Dep.

This report contains a research paper entitled "Floatability of Treated Coal in Water at Room Temperature." Experimental data on equilibrium adsorption loadings of probe compounds on coal, and flotation of raw coals as well as treated coal were obtained, using Illinois No. 6 coal (PSOC-1539), Adaville No. 1 coal (PSOC-1544), Wyodak coal (PSOC-1545) and Pittsburgh No. 8 coal (PSOC-1549). The raw data of this Annual Topical Report are also available in the Quarterly Progress Report for the period April–June 1993 and the Quarterly Progress Report July–September 1993.

20611 (DOE/PC/91290–T10) **Non-intrusive measurement of particle charge: Electrostatic dry coal cleaning: Technical progress report No. 11, January 1, 1994–March 31, 1994.** Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research. [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91290. Order Number DE94013476. Source: OSTI; NTIS; GPO Dep.

As has been previously reported, the charge measurement portion of this project has been broadened to include direct measurement techniques which yield an average particle charge per unit mass. These methods, which now include current measurements from the charging loop, an electrolytic collection solution and a Faraday cage have been employed to expand the charge measurement capabilities over those that were originally developed using the PDPA. The effects of gas velocity, humidity and temperature as well as particle size on charge was evaluated for different coals and silica. The charge accumulated on silica particles was linearly dependent on their velocity in the tribocharger for the velocities and mass loadings which were investigated. For coals, a linear increase in charge occurred over a more limited velocity range. Transport gas humidity had a much stronger effect on the charge established on silica particles than on coal particles.

20612 (DOE/PC/91310–T9) **The use of solid-state NMR techniques for the analysis of water in coal and the effect of different coal drying techniques on the structure and reactivity of coal: Quarterly report, December 1, 1993–February 28, 1994.** Netzel, D.A. Western Research Inst., Laramie, WY (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91310. Order Number DE94012599. Source: OSTI; NTIS; GPO Dep.

The overall objectives of this study are to develop a nuclear magnetic resonance (NMR) method for measuring the water in coal, to measure the changes in coal structure that occur during coal drying, to determine what effect water has on retrograde/condensation reactions, to determine the mechanism by which water may impact coal reactivity toward liquefaction, and to conduct D_2O exchange studies to ascertain the role of water in coal liquefaction. The objectives for this quarterly report period were (1) to train students in the operation of the coal liquefaction reactor, gas analysis, extraction of the coal residue and coal liquids, and to calculate the percent conversion from the coal liquefaction data; and (2) to implement the changes in the coal liquefaction experimental procedure.

20613 (DOE/PC/92251–T1) **Refining of fossil resin flotation concentrate from western coal: First quarterly final report, February 23, 1993–March 31, 1993.** Miller, J.D. Utah Univ., Salt Lake City, UT (United States). Dept. of Metallurgical Engineering. 30 Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-93PC92251. Order Number DE94011973. Source: OSTI; NTIS; GPO Dep.

During the first quarter of the project, from February 22, 1993 to March 31, 1993, the major work is to conduct project work plan and to organize the research term in order to successfully conduct this fossil resin refining project. Under a previous DOE-funded program, University of Utah and APT conducted a serious pilot-plant tests of selective flotation of fossil resin from Wasatch plateau coal (both UPL coal and CO-OP coal mines) of south central Utah. About 200 lbs high grade fossil resin flotation concentrate (approximate 75% resin content) was generated from those pilot-plant flotation tests. The resin flotation concentrate were naturally dried, sampled and storied into one kilo plastic bag for future use. The ash and moisture content of the resin concentrate is found to be 1.23% and 1.03 by weight respectively. As concluded from our previous research project, it was found that macroscopic fossil resin is friable and can be easily liberated from other coal macerals. Consequently the fossil resin particles tend to concentrate into the fine sizes during size reduction and coal preparation. Because of this property, the fine resinous coal streams in a coal preparation plant contain more than 6% hexane-soluble fossil resin, even when the run-of-mine coal contains only 3% fossil resin. Thus, the fossil

resin flotation concentrate contains more fine resin particles (−200 mesh). Under microscopic examination, it is also found that a notable amount of fine coal particle was still floated into the froth concentrate along with fossil resin particles.

20614 (DOE/PC/92521–T130) **Bench-scale development of mild gasification char desulfurization: Technical report, 1 December 1993–28 February 1994.** Knight, R.A. (Institute of Gas Technology, Chicago, IL (United States)). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 21p. Sponsored by USDOE, Washington, DC (United States);Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). DOE Contract FC22-92PC92521. Order Number DE94012557. Source: OSTI; NTIS; GPO Dep.

The goal of this project is to scale up a process, developed under a previous ICCI grant, for desulfurization of mild gasification char by treatment with hydrogen-rich process-derived fuel gas at 650–760 C and 7-15 atm. The char can be converted into a low-sulfur metallurgical form coke. In the prior study, IBC-105 coal with 4.0 wt % sulfur was converted to chars with less than 1.0 wt% sulfur was converted to chars with less than 1.0 wt % sulfur in a laboratory-scale batch reactor. The susceptibility of the char to desulfurization was correlated with physicochemical char properties and mild gasification conditions. Acid pretreatment of the coal prior to mild gasification was also shown to significantly enhance subsequent sulfur removal. In this study, IGT is conducting continuous bench-scale tests in a 1-lb/h fluidized-bed reactor to determine the preferred process conditions and obtain steady-state data necessary for process conditions and obtain steady-state data necessary for process design and scale-up. The desulfurized chars are to be used to produce low-sulfur form coke, which will be evaluated for density, reactivity, and strength properties relevant to utilization in blast furnaces. During the second quarter, the authors completed the acid pretreatment of 25 lb (11 kg) of the 40 x 80-mesh IBC-105 coal and 7 lb (3 kg) of carbonizer char. Modifications of the bench-scale fluidized-bed reactor were completed, permitting extended-duration char-producing runs with caking coal. Char-producing runs were initiated at 1100 F and 20 psig in nitrogen, and will continue into the third quarter.

20615 (DOE/PC/92521–T141) **Geochemistry of a reclaimed coal slurry impoundment: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Dreher, G.B. (Illinois State Geological Survey, Champaign, IL (United States)); Roy, W.R.; Steele, J.D.; Heidari, M. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012568. Source: OSTI; NTIS; GPO Dep.

The highly alkaline residue from the fluidized-bed combustion (FBC) of coal may be an environmentally acceptable material for use in neutralizing acid produced by the oxidation of pyrite in coal slurry solids (CSS). Previous research indicated that FBC residues in mixtures with pyrite-rich CSS neutralized the acid produced by or attenuated the oxidation of pyrite in CSS. In the present research we intend to collect cores of unconsolidation material and sample pore gases from a reclaimed coal slurry impoundment. The data gathered will provide background information necessary for the development of a predictive computer model of the generation and migration of acid in a reclaimed coal slurry impoundment. The conceptual model for the oxidation of pyrite at near-neutral conditions has been revised. The model is being built around the method of Morel and Hering (1993) and Westall (1986).

20616 (DOE/PC/92521–T143) **A comparison study of column flotation technologies for cleaning Illinois coal: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Honaker, R.Q. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Mining Engineering); Paul, B.C. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012570. Source: OSTI; NTIS; GPO Dep.

The objectives of this research project are to optimize the performance of six commercially available column technologies for the treatment of Illinois Basin coal fines and to compare their performance on the basis of the recovery-grade curve and column throughput capacity. A statistically-designed, experimental program will be conducted to optimize the critical operating performance values of each flotation column. During the previous reporting period, construction and installation of the six flotation columns were completed. The flotation feed sample that will be used for the tests in this investigation was collected from a coal preparation plant treating the Illinois No. 5 seam coal. During this reporting period, the flotation feed sample was characterized on a size-by-size basis for its ash, total sulfur, and BTU content. A release analysis was also conducted to obtain the best possible recovery versus product grade curve that can be achieved by a froth flotation process for the treatment of the Illinois No. 5 flotation feed sample. Experiments were initiated on the Jameson Cell. The preliminary results indicate that the Jameson Cell achieves a separation performance that is close to the release data. The experimental program on the Jameson Cell and the other flotation technologies will be performed during the next reporting period.

20617 (DOE/PC/92543–T6) **Micro-agglomerate flotation for deep cleaning of coal: Quarterly progress report, January 1–March 31, 1994.** Chander, S.; Hogg, R. Pennsylvania State Univ., University Park, PA (United States). Apr 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92543. Order Number DE94013466. Source: OSTI; NTIS; GPO Dep.

We are investigating the use of a hybrid process – Micro-agglomerate flotation which is a combination of oil-agglomeration and froth flotation. The basic concept is to use small quantities of oil to promote the formation of dense micro-agglomerates with minimal entrapment of water and mineral particles, and to use froth flotation to extract these micro-agglomerates from the water/dispersed-mineral phase. Since the floating units are agglomerates (about 30–50 μm in size) rather than individual coal particles (1–10 μm) the problems of froth overload and water/mineral carryover should be significantly alleviated. Micro-agglomerate flotation has considerable potential for the practical deep cleaning of coal on a commercial scale. In principle, it should be possible to achieve both high selectivity and high yield at reasonable cost. The process requires only conventional, off-the-shelf equipment and reagent usage (oil, surfactants, etc.) should be small. There are, however, complications. The process involves at least five phases- two or more solids (coal and mineral), two liquids (oil and water) and one gas (air). It is necessary to maintain precise control over the chemistry of the liquid phases in order to promote the interfacial reactions and interactions between phases necessary to ensure selectivity. Kinetics as well as thermodynamic factors may be critical in determining overall system response.

20618 (DOE/PC/92550–6) **Evaluation of hyperbaric filtration for fine coal dewatering: Sixth quarterly technical progress report, 1 January–31 March 1994.** Parekh, B.K. (Univ. of Kentucky, Lexington, KY (United States)); Hogg, R.; Fonseca, A. Kentucky Univ., Lexington, KY (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92550. Order Number DE94013494. Source: OSTI; NTIS; GPO Dep.

The main objectives of the project are to investigate the fundamental aspects of particle-liquid interaction in fine coal dewatering, to conduct laboratory and pilot plant studies on the applicability of hyperbaric filter systems and to develop process conditions for dewatering of fine clean coal to less than 20% moisture. The program consists of three phases, namely: model development; laboratory studies; and field testing. The Pennsylvania State University is developing a theoretical model for hyperbaric filtration systems, whereas the University of Kentucky is conducting experimental studies to investigate fundamental aspects of particle-liquid interaction and application of high pressure filter in fine coal dewatering. The optimum filtration conditions identified in Phase 1 and 2 will be tested in a Consol Inc. coal preparation plant using an Andritz Ruthner portable hyperbaric filtration unit. Progress to date is described.

20619 (DOE/PC/93203–T2) **Electrostatic beneficiation of coal: Quarterly technical progress report, January 1, 1994–March 31, 1994.** Mazumder, M.K. Arkansas Univ., Little Rock, AR (United States). 28 Apr 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93203. Order Number DE94012603. Source: OSTI; NTIS; GPO Dep.

Electrostatic beneficiation of dry coal has received significant attention in the last decade. In this process the coal is ground and then charged, either by corona charging or by triboelectrification (friction charging). Coal and minerals receive different levels of charge – often opposite polarities in the case of triboelectrification – and can then be separated based on differences in electrical mobility. Problems associated with the techniques include rapid deposition of particles on the electrodes, thus, effecting further separation. The goal of this project is to optimize the electrostatic coal cleaning process to remove pyrites and inorganic materials through studies of the electrostatic properties of powdered coal, in-situ measurements of the electrodynamics of coal and mineral particles inside the separator, and development of self-cleaning collector plates for continuous separation.

20620 (DOE/PETC/TR–94-02) **Upgrading of coal liquefaction feedstock by selective agglomeration.** Lai, R.; Sinha, K.; Richardson, A.; Killmeyer, R.; Utz, B.; Hickey, R.; Cillo, D. USDOE Pittsburgh Energy Technology Center, PA (United States). Mar 1994. 18p. Sponsored by USDOE, Washington, DC (United States). (CONF-910204–4: Society for Mining, Metallurgy and Exploration (SME) annual meeting and exhibit, Denver, CO (United States), 25-28 Feb 1991). Order Number DE94009955. Source: OSTI; NTIS; GPO Dep.

The technical feasibility study of using selective agglomeration (with coal-derived oil) to upgrade Illinois No. 6 coal for a liquefaction feedstock was completed. Effects of coal particle size, slurry pH, oil-to-coal ratio, and operating temperature on mineral matter reduction, clean coal weight recovery, and clean coal moisture content were studied. The addition of coal-derived naphtha or kerosene as conditioners to increase hydrophobicity and recovery of coal was also investigated. Results showed that approximately 70% of the mineral matter could be removed from this coal at a clean coal weight recovery of over 85% by grinding the coal to a mean volume diameter of about 10 microns and properly selecting of the operation variables.

0104 Processing

Refer also to citation(s) 20611, 20619, 20682, 20693, 20717, 20766, 21136, 21160, 21161, 21162, 21163, 21164, 21165, 21166, 21167, 21168, 21169, 21170, 21171, 21172, 21173, 21846, 22060, 22061, 22084, 22095, 22471, 22475, 22486, 22664

20621 (CONF-9309257–4) **Coal liquefaction process streams characterization and evaluation: An analytical characterization case study.** Brandes, S.D.; Robbins, G.A.; Winschel, R.A.; Burke, F.P. CONSOL, Inc., Library, PA (United States). Research and Development Dept. [1993]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. Order Number DE94012723. Source: OSTI; NTIS; GPO Dep.

Deactivation of the second-stage supported catalyst dominated most of the properties over the course of the run. Consequences of increased catalyst age were increases in aromaticity and phenolic -OH concentration and decreases in hydrogen donor content and paraffinic hydrogen content in most process streams, including product distillates. Donor solvent quality of the whole PFL increased through the early part of the run until Period 8 when it apparently stabilized. The properties of the net product oil and its distillate fractions, as determined by NIPER, show that the coal-derived material has some desirable qualities. The whole crude has a low sulfur content and boils below the maximum temperature allowed for the production of transportation fuels. The naphtha fraction (IBP-380°F) is highly naphthenic and has a low benzene content. The naphtha fraction appears to be amenable to mild hydrotreating to produce a good gasoline blendstock. The kerosene (380–510°F) fraction is much too cyclic for use as aviation fuel and it is recommended that this fraction be distributed into the two cuts on either end of it (diesel and gasoline feedstocks). The 510–680°F fraction met most specifications as a heating fuel and diesel fuel. It appears that this material, after moderate hydroprocessing, could make a good diesel blendstock. Both the FIMS and CP/MAS ^{13}C-NMR methods, currently being used to analyze the suite of twelve samples from HRI Run CC-15, are expected to provide chemical/molecular information to augment and extend the information provided by the base analyses. Preliminary information is encouraging.

20622 (CONF-9309257–Vol.2, pp. 661-684) **Heterogeneous catalytic process for alcohol fuels from syngas.** Minahan, D.M.; Nagaki, D.A.; Culp, G.; Duty, N. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

This project is focused on the discovery and evaluation of novel heterogeneous catalytic systems for the production of oxygenated fuel enhancers from synthesis gas. In particular, heterogeneous catalysts will be studied and optimized for the production of: (a) C_1-C_5 alcohols using conventional methanol synthesis conditions, and (b) methanol and isobutanol mixtures which may be used for the downstream synthesis of MTBE or related oxygenates. An additional aspect of the project is the exploration of novel reactor and process concepts to generate the best combination of chemistry, catalyst, reactor, and total process configuration in converting syngas to liquid fuel products. Work has concentrated on the development of catalysts for the selective production of methanol and isobutanol. Two general classes of catalysts are known for this reaction: (a) low temperature (300°C) copper metal based 'modified methanol' catalysts promoted with cesium and (b) high temperature (400°C) spinel oxide based catalysts also promoted with alkali. The addition of alkali to both systems results in the formation of isobutanol by what is believed to be a base-catalyzed aldol condensation mechanism. Kinetics and thermodynamics favor the formation of higher alcohols at higher temperatures, so we have concentrated our efforts on developing a spinel oxide based catalyst system.

20623 (CONF-9309257–Vol.2, pp. 685-700) **The economical production of alcohol fuels from coal-derived synthesis gas.** Whiting, W.B. (Resource Management, Morgantown, WV (United States)); Shaeiwitz, J.A.; Turton, R.; Maier, R.W.; Torries, T.F.; Saymansky, J.E.; Duty, N.M.; Culp, G.L.; Bannister, R.R.; Vredeveld, D.R. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

This program is dedicated to providing a cost effective process for converting coal-derived synthesis gas to liquid products useful as transportation fuels. One goal of this project is to develop and evaluate catalysts and reactors for the selective conversion of low hydrogen content syngas to alcohol fuel extenders and octane enhancers (Task 1). The target products are C_2-C_5 alcohols, which can be used with methanol as gasoline octane enhancers. The second goal is the design of economical, energy efficient processes to convert coal to syngas and then to higher alcohols (Task 2). Energy integration, cogeneration, fuel testing, and economic uncertainty are also being investigated. This report focuses on results from Task 2. Base case designs have been completed including Texaco and Shell gasifiers, with either natural gas or a sour gas shift converter to adjust the unfavorable H_2CO ratio exiting the gasifier. The alcohol synthesis reactor uses a MoS_2 catalyst and is of a shell and tube design previously proposed by Union Carbide Corporation. A comparison of the payback periods or production cost of these plants shows significant differences among the base cases. However, a natural gas only design, prepared for comparison purposes, gives a lower payback period or production cost. Since the alcohol synthesis portion of the above processes is the same, the best way to make coal-derived higher alcohols more attractive economically than natural gas-derived higher alcohols is by

making coal-derived syngas less expensive than natural gas-derived syngas.

20624 (CONF-9309257–Vol.2, pp. 1081-1099) **Fischer-Tropsch slurry reactor modeling.** Soong, Y. (Pittsburgh Energy Technology Center, PA (United States)); Boff, J.J.; Harke, F.W.; Blackwell, A.G.; Zarochak, M.F. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

This paper reports on the status of (1) preliminary results from the two phase hydrodynamic study and (2) the development of a new measurement technique in the project titled: Fischer-Tropsch Slurry Reactor Modeling. Hydrodynamic studies were conducted in a hot pressurized bubble column reactor. The hydrodynamic properties in a 10.16-cm diameter bubble column with a 5 × 1-mm perforated-plate gas distributor were studied from atmospheric pressure to 1.36 MPa, and from ambient temperature to 265°C, using a dual hot-wire probe, with nitrogen as the gas phase and Drakeol-10 oil as the liquid phase. Preliminary data show that the gas holdup in the column increased as temperature increased. The opposite trend is found on the bubble size. The bubble size decreases with increasing pressure and temperature at a constant superficial gas velocity.

20625 (DOE/EA–0916) **Self-scrubbing coal™: An integrated approach to clean air: A proposed Clean Coal Technology Demonstration Project.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Jan 1994. 158p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013018. Source: OSTI; NTIS; GPO Dep.

This environmental assessment (EA) was prepared by the U.S.Department of Energy (DOE), with compliance with the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CE) regulations for implementating NEPA (40 CFR 1500-1508) and DOE regulations for compliance with NEPA (10 CFR 1021), to evaluate the potential environmental impacts associated with a proposed demonstration project to be cost-shared by DOE and Custom Coals International (CCI) under the Clean Coal Technology (CCT) Demonstration Program of DOE's Office of Fossil Energy. CCI is a Pennsylvania general partnership located in Pittsburgh, PA engaged in the commercialization of advanced coal cleaning technologies. The proposed federal action is for DOE to provide, through a cooperative agreement with CCI, cost-shared funding support for the land acquisition, design, construction and demonstration of an advanced coal cleaning technology project, "Self-Scrubbing Coal: An Integrated Approach to Clean Air." The proposed demonstration project would take place on the site of the presently inactive Laurel Coal Preparation Plant in Shade Township, Somerset County, PA. A newly constructed, advanced design, coal preparation plant would replace the existing facility. The cleaned coal produced from this new facility would be fired in full-scale test burns at coal-fired electric utilities in Indiana, Ohio and PA as part of this project.

20626 (DOE/MC/10637–3663, pp. Paper, 1) **Flue gas cleanup.** Weber, G.F. (Univ. of North Dakota, Grand Forks, ND (United States)); Miller, S.J.; Laudal, D.L. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

In 1983 the Grand Forks Energy Technology Center of the U.S. Department of Energy was transferred to the University of North Dakota. From April 1, 1983, through June, 1987, the facility operated as a nonprofit contract research organization called the University of North Dakota Energy Research Center (UNDERC). In October 1989, the name was changed to the Energy and Environmental Research Center (EERC), University of North Dakota. Department of Energy programs ongoing at the time of the 1983 transfer were continued under a three-year Cooperative Agreement with the Department of Energy. In 1986 a second multiyear Cooperative Agreement (Contract No. DE-FC21-86MC10637) was signed by the Department of Energy. This report documents the results for the Flue Gas Cleanup project for the period July 1, 1989, through June 30, 1990. The highlights of previous work, current program goals and objectives, fourth-year accomplishments on a task basis, and conclusions based on work completed are summarized.

20627 (DOE/MC/10637–3663, pp. Paper 6, 20) **Liquefaction reactivity of low-rank coals.** Olson, E.S. (Univ. of North Dakota, Grand Forks, ND (United States)); Sharma, R.K. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

In the preceding decade, molten zinc chloride was demonstrated to be an effective catalyst for the production of clean gasoline fuels; however, some disadvantages relating to its corrosiveness and loss during regeneration were noted. During the last year we have extensively investigated supported forms of zinc chloride which may overcome these problems. Silica gel-supported zinc chloride was shown to be an effective catalyst for hydrotreating first-stage coal liquefaction products to a distillate fuel containing no sulfur. Higher conversions (53-68%) were obtained with this catalyst than that with a commercially available Ni-Mo catalyst (35%). Extensive studies with model compounds were carried out with the objective of achieving a better understanding of the chemistry of hydrotreating coal liquids with solid strong-acid catalysts. These studies showed that the silica gel-supported zinc chloride catalyst cleaves aryl sulfides, ethers, phenols, nitrogen heterocyclics, and alkylaromatic compounds. Alkyl transfer reactions also occur very readily. Molecular hydrogen is not utilized directly in the cleavage reaction, but it is needed to prevent coking and condensation reactions and is indirectly incorporated into products. Products are consistent with a mechanism involving formation of carbonium ion intermediates which are converted to products via hydride abstraction. The sources of the hydride ions apparently are various aromatic condensation intermediates. Tertiary alkanes are not effective hydride donors. Polynuclear aromatics are hydrogenated but single ring aromatics are not.

20628 (DOE/MC/10637–3663, pp. Paper 7, 60) **Gasification ash and slag characterization.** Ness, S.R. (Univ. of North Dakota, Grand Forks, ND (United States)); Nowok, J.W.; Benson, S.A. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The purpose of this project is to develop a unified picture of the behavior of inorganic coal constituents in gasification systems. To achieve this goal, the reactions and interactions between inorganic constituents, partitioning of ash components, physical properties, and sintering behavior of ash under gasification conditions must be characterized and interrelated. During the 1989-1990 fiscal year, the Gasification Ash and Slag project Characterization has focused on two main areas. The goals of the first area, characterization of reactions and interactions between inorganic constituents has been accomplished for 5 coals and the chars produced from them, in a 5-10 gram batch pressurized pyrolysis unit under reducing conditions. The second area, slag surface tension measurement, has been studied, resulting in the determination of several physicochemical effects which affect the measurement. Also, strength measurements and sintering studies were performed on various coal ashes and coal ashes with dolomite and limestone additives. The results indicate that interfacial surface tension measurements obtained below the temperature of critical viscosity (T_{cv}) were lower than that determined above T_{cv}. This effect was attributed to a nonequilibrium state of surface tension due to the random distribution of surface active phases in the slag and higher polymerization of silicate structure. The interfacial surface tensions did not vary significantly with temperatures above T_{cv}.

20629 (DOE/MC/10637–3663, pp. Paper 8, 16) **Coal ash behavior in reducing environments.** Benson, S.A. (Univ. of North Dakota Energy and Environmental Research Center, Grand Forks, ND (United States)); Jones, M.L.; Steadman, E.N. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental

Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

A key factor in the successful design and operation of coal gasification and advanced combustion systems is the ability to control and mitigate ash-related problems. Some of the major ash-related problems are slag flow control, slag attack on the refractory, ash deposition on heat transfer surfaces, corrosion and erosion of equipment materials, and emissions control. Such problems are closely tied to the abundance and association of the inorganic components in coal and the system conditions.

20630 (DOE/MC/10637–3663, pp. Paper 15, 26) **Low-rank coal direct liquefaction.** Rindt, J.R. (Univ. of North Dakota, Grand Forks, ND (United States)); Hetland, M.D.; Knudson, C.L. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

To expand the scientific and engineering data base of low-rank coal (LRC) liquefaction, investigations of direct liquefaction processes that produce the most competitive feedstocks or liquid fuels must be investigated. Coal can be converted to very high yields of oils with increasing levels of efficiency using a two-stage processing approach. To obtain even higher yields, however, it may be necessary to control the processing conditions to which coal is subjected in a manner that significantly reduces the role that repolymerization, recombination, and/or coking reactions play in the conversion process.

20631 (DOE/MC/10637–3663, pp. Paper 16, 52) **Production of hydrogen and by-products from coal.** Hauserman, W.B. (Univ. of North Dakota, Grand Forks, ND (United States)); Cisney, S.J.; Heidt, M.K.; Timpe, R.C.; Haley, J.S. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

Coal gasification products consists of char solids, condensables, and gases. A flexible processing system that allows variation of products to meet market demand would substantially improve the marketability of coal. Such a processing system could integrate catalytic gasification and mild gasification (MG) of coal. Operating temperatures range from 500° to 800°C, at nominally atmospheric pressure. A hybrid system based on these two technologies should have the flexibility to optimize production of one, two, or all three of the products depending upon market demand.

20632 (DOE/MC/10637–3663, pp. Paper 17, 20) **Sulfur removal from coal/mild gasification char.** Ness, R.O. Jr. (Univ. of North Dakota, Grand Forks, ND (United States)); Aulich, T.R. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The objective of this research was to develop analytical methods for quantitating the sulfur forms in coal and char. Better analytical methods are needed to more accurately determine the chemistry of the sulfur contained in raw coal and char, to enable development of effective means for sulfur removal from coal– either during or before mild gasification char production. A primary goal of this work is to develop techniques for directly quantitating the pyritic and organic sulfur in coal and chars. Direct measurement techniques are needed, because in the American Society for Testing and Materials (ASTM) method for determining sulfur forms in coal, the pyritic sulfur content is calculated based on the amount of iron extracted from the coal using nitric acid, and the organic sulfur content is calculate to be the difference between the sum of the pyritic and sulfatic sulfur contents and the total sulfur content. for coals (and chars) with a significant quantities of nitric acid-soluble iron in forms other than pyrite (such as pyrrhotite and iron oxides), the ASTM method may provide an inaccurate measurement of pyritic sulfur content, which would also result in an inaccurate measurement of organic sulfur content. It should be noted that the instructions published with the description of the ASTM sulfur forms analysis explicitly state that the method is not suitable for the analysis of coke. The research is divided into two tasks: analytical methods development and char characterization. The analytical methods developed will be used (in addition to ASTM methods) to quantitate sulfur in chars produced in the 1-lb/hr continuous fluid-bed reactor (CFBR) at the University of North Dakota Energy and Environmental Research Center (EERC) as a means of evaluating in situ sulfur removal techniques for incorporation into the mild gasification process under development at EERC. Also analyzed were chars made in a thermogravimetric analysis (TGA) instrument.

20633 (DOE/MC/10637–3703, pp. Paper 7, 18) **Liquefaction reactivity of low-rank coals.** Olson, E.S. (Univ. of North Dakota, Grand Forks, ND (United States)); Sharma, R.K. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The development of new catalysts for coal liquefaction was continued. The catalysts currently being investigated are basically homogeneous catalysts for first-stage coal solubilization and preliminary reduction. Catalysis of the first stage of coal liquefaction involves improving the rates of bond cleavage reactions leading to improved solubility and of preliminary reduction reactions so that oils and asphaltene are produced without extensive retrogressive reactions. These materials should be able to effectively interact with the solid and colloidal coal matter, catalyzing the conversion to soluble oils at moderate temperature, while minimizing problems with low surface areas or mass transfer. Thus various inorganic agents that are soluble in the reaction vehicle or solvent are being investigated. Some are precursors for the clays and zeolites that are currently under investigation as second-stage liquefaction catalysts.

20634 (DOE/MC/10637–3703, pp. Paper 8, 13) **Gasification ash and slag characterization.** Steadman, E. (Univ. of North Dakota, Grand Forks, ND (United States)); Nowok, J.; Benson, S. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

In combustion and gasification systems, a buildup of deposits on heat-transfer surfaces in the convective pass reduces the heat transfer. Therefore, it is important to know the thermal conductivity of the deposited coal ashes to predict the energy loss on the boiler tube heat-transfer surfaces. In this project the Energy and Environmental Research Center (EERC) has developed an apparatus to measure the thermoconductivity of coal ashes. The thermal conductivity is defined as the proportionality coefficient between the heat flux passing through a material and the temperature gradient resulting from the causative heat flux. This arises from the lattice thermal conduction, k_l; the electronic thermal conduction, k_e; and ionic thermal conduction, k_i. The latter factor usually occurs at high temperatures and is a result of the transport of mobile alkali metal ions.

20635 (DOE/MC/10637–3703, pp. Paper 11, 32) **Beneficiation of low-rank coals.** Musich, M.A. (Univ. of North Dakota, Grand Forks, ND (United States)); Anderson, C.M.; DeWall, R.A.; Timpe, R.C.; Richter, J.J. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

LRCs (lignitic, subbituminous, and brown) are characterized by a number of qualities which make them ideal for combustion and/or conversion processes. The inherent alkali content and high volatile-matter content of the LRCs make them ideally suited as a gasification feedstock. The low-sulfur content of some subbituminous coals makes them compliance coals for power generation. Additionally, most LRCs are low in ash and are inexpensively strip-mined. Even though these LRCs are plentiful in southern coast states, between the Mississippi River and the Rocky Mountains, and, most certainly, in Alaska, their marketability has been restricted by their high moisture and, consequently, low energy contents. Additionally, the fouling problems associated with the

high sodium content have inhibited the use of some LRCs. Considerable effort has been put forth to develop processes which increase energy content and reduce mineral content, yet produce a competitively priced feedstock from LRCs.

20636 (DOE/MC/10637–3703, pp. Paper 14, 10) **Low-rank coal direct liquefaction.** Rindt, J.R. (Univ. of North Dakota, Grand Forks, ND (United States)); Hetland, M.D. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

To expand the scientific and engineering database of low-rank coal (LRC) liquefaction, investigations of direct liquefaction processes that produce the most competitive feedstocks or liquid fuels must be investigated. Coal can be converted to very high yields of oils with increasing levels of efficiency using a two-stage processing approach. Current two-state direct liquefaction processes are usually performed with high-rank coals at temperature greater than 400°C and pressures of approximately 2500 psi. Catalysts, which are very expensive, are generally used in both stages. While the economics of direct liquefaction have improved during the last five years, it is not yet a commercially viable method of producing liquid fuels due to its use of catalysts in both stages and the severity of the conditions employed.

20637 (DOE/MC/10637–3703, pp. Paper 16, 8) **The definition and measurement of char reactivity in coal and wood gasification processes.** Timpe, R.C. (Univ. of North Dakota, Grand Forks, ND (United States)); Hauserman, W.B. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The objective of gasification of coal or biomass is to convert the solid feed to the maximum possible amount of organic gases and/or condensible vapors, at the maximum possible rate, consuming the minimum heat from partial combustion of feed to supply the heat of reaction. This transition from solid carbon to a highly variable mixture of gases during gasification is the result of a complex interplay of many different chemical reaction. The overall rate is dominated by the well-known steam-char reaction: $C + H_2O \rightarrow H_2 + CO$ and $C + 2H_2O \rightarrow 2H_2 + CO_2$. There are of course many concurrent reactions that happen, at various rates determined by distribution of intermediates in reacting system, by temperature and pressure, by the presence of catalysts and by the structure of the carbonaceous feed. The most significant of these reactions are described.

20638 (DOE/MC/10637–3703, pp. Paper 17, 12) **Two examples of complete printouts for analysis of data from EERCS Continuous Process Unit (CPU), operating in the gasification mode.** Timpe, R.C. (North Dakota, Grand Forks, ND (United States)); Hauserman, W.B. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

Two examples are presented for the analysis of data from EERC's continuous process unit (CPU) operating in the gasification mode. These are Run M-224 which was for KOH-impregnated Wyodak coal in a limestone bed and Run M-233 which was for KOH-impregnated coal in a taconite bed. The first sheet in each set consists of a condensation of raw, on-line data generated by CPU operators. These data, plus laboratory analyses of all gas, solid, and (if desired) liquid products are inputs to Lotus file DPUDATA. WKI which generates a minimum of five subsequent sheets.

20639 (DOE/MC/21023–94/C0340) **Effect of paste water content on APFBC plant efficiency.** Robertson, A. (Foster Wheeler Development Corp., Livingston, NJ (United States)); Domeracki, W.; Horazak,; Newby, R.; Rehmat, A. Foster Wheeler Development Corp., Livingston, NJ (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC21023. (CONF-9405124–3: Electric Power Research Institute (EPRI) fluidized-bed combustion for power generation conference, Atlanta, GA (United States), 17-19 May 1994). Order Number DE94012760. Source: OSTI; NTIS; GPO Dep.

In the search for a more efficient, less costly, and more environmentally responsible method for generating electrical power from coal, research and development has turned to advanced pressurized fluidized bed combustion (PFBC) and coal gasification technologies. A logical extension of this work is the second-generation PFBC plant, which incorporates key components of each of these technologies. In this new type of plant, coal is devolatilized/carbonized before it is injected into the PFB combustor bed, and the low-Btu fuel gas produced by this process is burned in a gas turbine topping combustor. By integrating coal carbonization with PFB coal/char combustion, gas turbine inlet temperatures of 1260°C (2300°F) and higher can be achieved. When operated with a dry coal-fed 871°C (1600°F) carbonizer and integrated with a conventional 16.5-MPa gage/538°C/538°C/8.5-kPa Hg (2400-psig/1000°F/1000°F/2.5-in. Hg) steam cycle, a plant electrical generating efficiency of 46.2 percent is predicted. Despite a loss in plant efficiency, first-generation PFB plants have been built with coal/water paste fuel systems because they offer advantages of simplicity and lower capital costs. The performance of second-generation PFB plants operating with coal paste water contents of 25 and 30 percent are presented in the paper.

20640 (DOE/METC/C–94/7129) **Evaluating ceramic filter media on a slipstream of hot flue gas.** Bush, P.V. (Southern Research Inst., Birmingham, AL (United States)); Pontius, D.H.; Dorchak, T.P. USDOE Morgantown Energy Technology Center, WV (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26239. (CONF-9405145–2: 1994 American Filtration and Separation Society national meeting, Chicago, IL (United States), 9-11 May 1994). Order Number DE94012396. Source: OSTI; NTIS; GPO Dep.

The need for more efficient systems for generating electric power from coal has led to a number of new technological developments, including such processes as pressurized fluidized-bed combustion (PFBC) and integrated gasification combined-cycle (IGCC) systems. To achieve maximum efficiency, a common and critical requirement for these technologies is a method for removing suspended particulate matter from the gas stream at high temperatures (above 1000 F) and high pressures (greater than 10 bar). The US Department of Energy's Morgantown Energy Technology Center (METC) is pursuing the development of such hot gas cleanup methods through an extensive program of fundamental and pilot studies in cooperation with utilities, supporting industries, and other research organizations. As a part of this program, Southern Research Institute (SRI) is carrying out a series of studies using a high-temperature sidestream device for performing long-duration tests on small specimens (patches) of filter materials on a process gas stream from an atmospheric-pressure fluidized-bed combuster. SRI developed an apparatus and a test plan to accomplish three of METC's objectives: (1) to determine the effects on ceramic filters of long-term filtration of particle-laden flue gases at high temperatures, (2) to compare the filtration performance of several kinds of filters, and (3) to simulate the Plant Tidd ash loading on filters so that results from these tests could be used to help select filters for use at the Tidd 10 MW pilot-scale facility. Preliminary results are discussed.

20641 (DOE/MT/93005–1) **Simultaneous removal of H_2S and NH_3 in coal gasification processes: [Quarterly] report, September 2, 1993–December 31, 1993.** Jothimurugesan, K.; Adeyiga, A.A.; Gangwal, S.K.; Lewis, C.; Bunch, A. Hampton Univ., VA (United States). Dept. of Engineering. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93MT93005. Order Number DE94013987. Source: OSTI; NTIS; GPO Dep.

Nitrogen (N_2) occurs in coal in the form of tightly bound organic ring compounds typically at levels of 1 to 2 wt % on a dry-ash-free basis. During, coal gasification, this fuelbound nitrogen is released principally as ammonia and nitrogen, with smaller levels of HCN. The formation of NH_3 in a coal gasification processes is a function of the fuel gas composition and the gasifier operating conditions.

During the use of coal gas to generate electricity in gas-fired turbines, fuel bound (N_2) is converted to nitrogen oxides (NO_x), which are difficult to remove and are highly undesirable as atmospheric pollutants. Recent results indicate that while the efficiency of molten carbonate fuel cell (MCFC) anodes is not effected by exposure to NH_3, NO_x is generated during combustion of the anode exhaust gas. Thus, NH_3 must be removed from the coal gas before it is used in IGCC or MCFC applications. The product stream from a high temperature, oxygen-blown gasifier, such as Texaco, contains about 2000 ppmv of NH_3, where higher concentrations (about 5000 ppmv) occur when the gasification is conducted at lower temperatures, such as in the Lurgi or GE air-blown gasifier. A range of 1500 to 3000 ppmv is considered for this study. Removal of H_2S using zinc-based sorbents, particularly zinc titanate, to < 20 ppmv levels has been well established (Lew et al., 1989; Jothimurugesan and Harrison, 1990; Woods et al., 1990; Gupta and Gangwal, 1993,). Studies of NH_3 decomposition indicated that Ni, Ir, Co, Mo, Mn and Ru have high catalytic activities (Krishnan et al., 1988). If desulfurization sorbents such as zinc titanate could be used along with above metals to decompose ammonia present in hot coal then the number of unit processes necessary to clean hot coal gas could be reduced by one.

20642 (DOE/PC/79818–T10) **Bench-scale co-processing: Technical progress reports No. 17–20, July 1, 1992–June 30, 1993.** Gala, H.B. UOP, Inc., Des Plaines, IL (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79818. Order Number DE94012595. Source: OSTI; NTIS; GPO Dep.

UOP's second co-processing contract, DE-AC22-87PC79818, began in April 1988. The major objective of this contract is to establish a database for the optimization of the co-processing concept by improving the effectiveness of the co-processing catalyst system. Two major mechanisms for improving the catalyst system are to be investigated: employment of more effective catalysts and utilization of improved catalytic environments. These two mechanisms are defined in the contract Statement of Work under Task 3.2 as Subtask 3.2.1 and 3.2.2, respectively. This report covers a span of four quarters, starting from July 1, 1992 to June 30, 1993. During this period the project was in a hold. As explained below, a request was made to add more funds to the contract to investigate catalytic environment improvements. Most of the time during this four quarters was spent in preparation of the proposal, review of the proposal by PETC, and getting additional funding approved for the contract. No experimental work was carried out on any of the tasks of the contract during these four quarters. Prior to the period covered by this report, UOP had successfully completed Subtask 3.2.1 and identified a molybdenum-based catalyst that is highly active and effective in achieving improved co-processing performance at significantly lower metal concentrations (0.05 % – 0.1 % by weight of Mo) in the catalyst. The new catalyst was developed in slurry autoclave tests demonstrated in the continuous bench-scale pilot plant.

20643 (DOE/PC/79818–T11) **Bench-scale co-processing: Technical progress report No. 22, October 1, 1993–December 31, 1993.** Duttlinger, M.L.M.; Commisaris, S.E.; Davis, L.A.; Yurek, R.W.; Gatsis, J.G.; Roemisch, R.; Kojima, M. UOP, Inc., Des Plaines, IL (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79818. Order Number DE94013073. Source: OSTI; NTIS; GPO Dep.

The major objective of this contract is to establish a database for the optimization of the co-processing concept by improving the effectiveness of the co-processing catalyst system. Two major mechanisms for improving the catalyst system are to be investigated: employment of more effective catalysts and utilization of improved catalytic environments. This report covers the period of October 1, 1993 to December 31, 1993. During this period work on Subtask 3.2.2, Improvement in Catalytic Environment, was carried out and the bench-scale co-processing pilot plant was operated in the co-current mode with product recycle and increased catalyst concentration. The project objective was to achieve 90+ % conversion of the 510°C+ non-distillables at 2800 psig. Currently work is on-going in a stirred autoclave at the same catalyst concentration as that in the runs reported here, and the results of these autoclave runs will be summarized in Technical Progress Report No. 23.

20644 (DOE/PC/89775–T1) **Control of catalytic hydrotreating selectivity with ammonia: Final technical report.** Satterfield, C.N.; Lee, C.; Gultekin, S. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering. Nov 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89775. Order Number DE94012783. Source: OSTI; NTIS; GPO Dep.

The purpose of this study was to explore the possibility of control of product selectivity in the hydroprocessing of coal liquids and related substances by adding small amounts of ammonia. Quinoline was used in this study and in many others as representative of heterocyclic N compounds found in coal liquids. Coal liquids also contain hydroxy pyridines, but by studies with 8-OH quinoline, a representative compound (Part I), we demonstrated that the OH group was rapidly removed at the beginning of reaction to form quinoline, which reacted in the same manner as quinoline fed as such. In Part II we showed that in a mixture of naphthalene and quinoline, with the addition of ammonia there is an operating region in which complete HDN of quinoline can be achieved, but with greater conversion of naphthalene to tetralin instead of to decalin than was the case in the absence of added ammonia. This is of some significance to coal liquefaction since tetralin is a good hydrogen donor, but decalin is not. In Part III we showed that NH_3 addition to a mixture of quinoline and phenanthrene provides an operating region where complete HDN of quinoline can be achieved with reduced formation of hydrogenated phenanthrenes and cracking to biphenyl. Part IV, a study of the hydrodeoxygenation (DHO) of dibenzofuran in the presence of naphthalene, showed that NH_3 strongly inhibits HDO reactions and its effects on naphthalene here were much the same as in Part II. In Part V it was demonstrated that in the hydrotreating of propylbenzene, the addition of ammonia increased the selectivity towards ring hydrogenation (generally desired for reformulated motor fuels) and away from dealkylation (generally undesired), but the overall reaction rate at a fixed temperature drops substantially.

20645 (DOE/PC/89869–T14) **Development of a stable cobalt-ruthenium Fischer-Tropsch catalyst: Technical progress report No. 15, 1 April 1993–30 June 1993.** Frame, R.R.; Gala, H.B. UOP, Inc., Des Plaines, IL (United States). [1994]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89869. Order Number DE94013074. Source: OSTI; NTIS; GPO Dep.

The high cobalt catalyst described in the previous quarterly report of this contract has been bound and evaluated in the fixed-bed and slurry autoclave pilot plants. The fixed-bed test showed it to be less active after binding than before. The purpose of binding is to provide a granular catalyst suitable for use in liquid phase Fischer-Tropsch (LPFT) processing. In such processing a granular catalyst is required to facilitate its separation from the FT wax product by mechanical means. The bound catalyst was evaluated in the slurry autoclave under LPFT conditions. In this test the temperature of the catalyst could be more precisely controlled at target than in the fixed-bed test due to the large amount of diluent and continual stirring. When operated at a temperature sufficient to induce the same conversion as in the fixed-bed test, the methane selectivity was 10 mole % — 2% less than in the fixed-bed test. The high cobalt catalyst, bound and unbound, in the fixed-bed or slurry autoclave pilot plants, was not conversion stable. At a given temperature it seemed to approach a conversion line out, however, catalysts more stable at high conversion are required. The unbound catalyst contained more cobalt than previous unbound catalysts in this work. Furthermore, it contained a small amount of ruthenium. Either or both of these properties could have been responsible for the superior activity.

20646 (DOE/PC/89869–T15) **Development of a stable cobalt-ruthenium Fischer-Tropsch catalyst: Technical progress report No. 16.** Frame, R.R.; Gala, H.B. UOP, Inc., Des Plaines, IL (United States). [1994]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89869. Order Number DE94013075. Source: OSTI; NTIS; GPO Dep.

Initial experiments have been performed to determine the best activation procedure for the high cobalt, high activity, Y zeolite-supported F-T catalyst. At this time the temperature used for the lower cobalt-level catalyst appears to be the best. Future activation experiments should be done at lower temperatures, but for longer periods of time. The runs outlined in this report and several in earlier reports were done with the standard reactor loading of 13 g but with high activity catalysts. In all of these runs a significant temperature exotherm was observed on the catalyst bed. In future runs less catalyst will be used with the same or more quartz sand diluent. This should reduce or eliminate the catalyst bed exotherm and make it easier to evaluate two different catalysts at the same temperature.

20647 (DOE/PC/89869–T16) **Development of a stable cobalt-ruthenium Fischer-Tropsch catalyst: Technical progress report No. 17, 1 November 1993–31 December 1993.** Frame, R.R.; Gala, H.B. UOP, Inc., Des Plaines, IL (United States). [1994]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89869. Order Number DE94013076. Source: OSTI; NTIS; GPO Dep.

Very high cobalt catalysts have been prepared on steamed and acid-washed y zeolite. These catalysts are very active. Some of them have proven to be very stable. Additionally, if provisions are made to control the temperature build up on the catalyst bed, low methane selectivities result. Additional work is indicated, for instance, perhaps even higher activity catalysts can result from higher levels of cobalt or changes in the catalyst preparation procedure. Since the issue of whether small amounts of ruthenium can promote the catalyst is not completely resolved, catalyst preparation procedure experiments should continue with ruthenium vs. ruthenium-free catalysts. For instance, different methods of impregnation and/or activation should be investigated.

20648 (DOE/PC/89883–86) **Coal liquefaction process streams characterization and evaluation: Quarterly technical progress report, July 1–September 30, 1993.** Robbins, G.A.; Brandes, S.D.; Winschel, R.A.; Burke, F.P. CONSOL, Inc., Library, PA (United States). Mar 1994. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE94012617. Source: OSTI; NTIS; GPO Dep.

This is the Sixteenth Quarterly Technical Progress Report under DOE Contract DE-AC22-89PC89883. Major topics reported are: Fifty-eight process samples from HRI CTSL Bench Unit Run CC-15 (227-75) were analyzed to provide information on process performance. Run CC-15 was operated for 14 periods (days) from October 21 through November 3, 1992 in the thermal/catalytic configuration with Black Thunder Mine (Wyodak and Anderson seams) coal and Shell S-317 Ni/Mo supported extrudate catalyst. The run was made to test performance with and without a dispersed hydrous iron hydroxide catalyst precursor impregnated in the coal. Results are compared with those of previous HRI CTSL bench unit Run CC-1, which was operated in the catalytic/catalytic configuration, also with Shell S-317 catalyst. Several HRI Run CC-15 product distillate fractions prepared by the National Institute for Petroleum and Energy Research (NIPER) for petroleum inspection tests were further characterized by CONSOL. These characterization data are presented. MicroAutoclave tests and chemical analyses were performed to evaluate the solvent quality of two potential solvents for Alberta Research Council ARC. Eight product samples from catalytic dehydrogenation experiments were characterized for the University of Pittsburgh. A description is presented of the thermogravimetric analysis (TGA) method for determination of resid concentration/resid conversion, which was adapted for use in-house from HRI's standard method. A brief summary of the status of the Participants Program is given.

20649 (DOE/PC/89883–87) **Coal liquefaction process streams characterization and evaluation: Assessment of hydroaromatic content and hydrogen donor ability of coal liquefaction intermediates by means of catalytic dehydrogenation.** Tierney, J.W. (Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering); Wender, I. Consolidation Coal Co., Library, PA (United States). Research and Development Dept.; Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. Feb 1994. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE94010270. Source: OSTI; NTIS; GPO Dep.

This study demonstrated the feasibility of using catalytic dehydrogenation for the examination of direct coal liquefaction process-derived materials. The technique, which was developed for the examination of coals, was applied to the 850°F+ distillation resids of process stream samples and the tetrahydrofuran (THF)-soluble portion of those resids. Additionally, selected resid samples were silylated to block phenolic –OH groups, then subjected to the catalytic removal of hydroaromatic hydrogen to determine the effect of phenolics on hydrogen evolution and hydrogen transfer ability of the resids. The results of this study indicate that the dehydrogenation method may, with additional development, become a useful tool for the analysis of the process-derived materials. This report describes the work performed at the University of Pittsburgh under a subcontract from CONSOL Inc., Research and Development. CONSOL's prime contract to the US Department of Energy (Contract No. DE-AC22-89PC89883 "Coal Liquefaction Process Streams Characterization and Evaluation") established a program for the analysis of direct coal liquefaction derived materials. The program involves a number of participating organizations whose analytical expertise is being applied to these materials.

20650 (DOE/PC/89883–90) **Coal liquefaction process streams characterization and evaluation: Analysis of Black Thunder coal and liquefaction products from HRI Bench Unit Run CC-15.** Pugmire, R.J. (Utah Univ., Salt Lake City, UT (United States)); Solum, M.S. Consolidation Coal Co., Library, PA (United States). Research and Development Dept.; Utah Univ., Salt Lake City, UT (United States). Feb 1994. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE94010688. Source: OSTI; NTIS; GPO Dep.

This study was designed to apply ^{13}C-nuclear magnetic resonance (NMR) spectrometry to the analysis of direct coal liquefaction process-stream materials. ^{13}C-NMR was shown to have a high potential for application to direct coal liquefaction-derived samples in Phase II of this program. In this Phase III project, ^{13}C-NMR was applied to a set of samples derived from the HRI Inc. bench-scale liquefaction Run CC-15. The samples include the feed coal, net products and intermediate streams from three operating periods of the run. High-resolution ^{13}C-NMR data were obtained for the liquid samples and solid-state CP/MAS ^{13}C-NMR data were obtained for the coal and filter-cake samples. The ^{1}C-NMR technique is used to derive a set of twelve carbon structural parameters for each sample (CONSOL Table A). Average molecular structural descriptors can then be derived from these parameters (CONSOL Table B).

20651 (DOE/PC/89883–91) **Coal liquefaction process streams characterization and evaluation: FIMS analysis of direct coal liquefaction process streams.** Malhotra, R. (SRI International, Menlo Park, CA (United States)); McMillen, D.F. Consolidation Coal Co., Library, PA (United States). Research and Development Dept.; SRI International, Menlo Park, CA (United States). Mar 1994. 169p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE94011112. Source: OSTI; NTIS; GPO Dep.

This study was designed to apply the method of field ionization mass spectrometry (FIMS) for the analysis of direct coal liquefaction process-stream samples. The FIMS method was shown to have a high potential for application to direct coal liquefaction-derived samples in a Phase 1 project in this program. In this Phase 3 project, the FIMS method was applied to a set of samples produced in HRI bench-scale liquefaction Runs CC-15 and CC-16. FIMS was used to obtain the molecular weight profile of the samples and to identify specific prominent peaks in the low end (160–420 Da) region of the molecular weight profile. In the samples examined in this study, species were identified which previously were recognized as precursors to the formation of high molecular weight structures associated with the formation of coke in petroleum vacuum gas oils.

20652 (DOE/PC/90295–T12) **A study of the interfacial chemistry of pyrite and coal in fine coal cleaning using flotation.** Jiang, C. Kentucky Univ., Lexington, KY (United States). Research Foundation. 1993. 197p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90295. Order Number DE94013472. Source: OSTI; NTIS; GPO Dep.

Surface oxidation, surface charge, and flotation properties have been systematically studied for coal, coal-pyrite and ore-pyrite. Electrochemical studies show that coal-pyrite exhibits much higher and more complex surface oxidation than ore-pyrite and its oxidation rate depends strongly on the carbon/coal content. Flotation studies indicate that pyrites have no self-induced floatability. Fuel oil significantly improves the floatability of coal and induces considerable flotation for coal-pyrite due to the hydrophobic interaction of fuel oil with the carbon/coal inclusions on the pyrite surface. Xanthate is a good collector for ore-pyrite but a poor collector for coal and coal-pyrite. The results from thermodynamic calculations, flotation and zeta potential measurements show that iron ions greatly affect the flotation of pyrite with xanthate and fuel oil. Various organic and inorganic chemicals have been examined for depressing coal-pyrite. It was found, for the first time, that sodium pyrophosphate is an effective depressant for coal-pyrite. Solution chemistry shows that pyrophosphate reacts with iron ions to form stable iron pyrophosphate complexes. Using pyrophosphate, the complete separation of pyrite from coal can be realized over a wide pH range at relatively low dosage.

20653 (DOE/PC/91039–T9) **Highly dispersed catalysts for coal liquefaction: Quarterly report No. 9, August 23, 1993–November 22, 1993.** Hirschon, A.S.; Wilson, R.B. Stanford Linear Accelerator Center, Menlo Park, CA (United States). 15 Feb 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91039. Order Number DE94013060. Source: OSTI; NTIS; GPO Dep.

We analyzed two sets of liquefaction experiments, one involved the liquefaction of Black Thunder Coal with the corresponding recycle vehicle, and the second set of liquefaction runs involved the liquefaction of Argonne North Dakota Lignite. We compared coal conversions of Black Thunder coal and recycle solvent using $Fe(CO)_5$ and carbon monoxide/hydrogen atmospheres and a MolyVanL molybdenum catalyst under a hydrogen atmosphere. We also continued our investigation of the effect of water on the conversions. We found that addition of water seemed to decrease the amount of oils; we determined the effect of water with the recycle solvent alone, (no coal added) under similar conditions, and again produced a decrease in oil yields. FIMS analyses of the hexane and toluene soluble fractions seem to indicate that in the experiment when water was added, a considerable amount of light material remained behind in the toluene layer, suggesting that somehow the addition of water decreased the amount of extracted material, perhaps by increasing the amount of polarity of the product. When the conversion was conducted with the MolyVanL molybdenum catalyst a good quality product in terms of lower viscosity was produced; however, conversions to THF soluble material was not increased. We believe the molybdenum catalyst hydrogenated the recycle vehicle rather than effectively converted the coal. In order to eliminate the effect of solvent we have often conducted experiments in an inert solvent with Argonne coals. We conducted several coal conversions experiments using an Argonne North Dakota lignite. We compared several dispersed Fe catalysts and in addition, a nickel catalyst. We investigated nickel as a catalyst since we believe this metal may be more effective in decarboxylating low rank coals. Consistent with this premise we found that the nickel catalyst gave the highest conversions.

20654 (DOE/PC/91041–T8) **Preconversion processing of bituminous coals: New directions to improved direct catalytic coal liquefaction: Final report, September 20, 1991–September 19, 1993.** Viking Systems International, Inc., Pittsburgh, PA (United States). Sep 1993. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91041. Order Number DE94005037. Source: OSTI; NTIS; GPO Dep.

One of the main goals for competitive coal liquefaction is to decrease gas yields to reduce hydrogen consumption. Complexing this element as methane and ethane decreases process efficiently and is less cost effective. To decrease the gas yield and increase the liquid yield, an effective preconversion process has been explored on the basis of the physically associated molecular nature of coal. Activities have been focused on two issues: (1) maximizing the dissolution of associated coal and (2) defining the different reactivity associated with a wide molecular weight distribution. Two-step soaking at 350°C and 400°C in a recycle oil was found to be very effective for coal solubilization. No additional chemicals, catalysts, and hydrogen are required for this preconversion process. High-volatile bituminous coals tested before liquefaction showed 80–90% conversion with 50–55% oil yields. New preconversion steps suggested are as follows: (1) dissolution of coal with two-step high-temperature soaking, (2) separation into oil and heavy fractions of dissolved coal with vacuum distillation, and (3) selective liquefaction of the separated heavy fractions under relatively mild conditions. Laboratory scale tests of the proposed procedure mode using a small autoclave showed a 30% increase in the oil yield with a 15–20% decrease in the gas yield. This batch operation projects a substantial reduction in the ultimate cost of coal liquefaction.

20655 (DOE/PC/91164–T8) **Development of the selective hydrophobic coagulation process: Technical progess report for the eighth quarter, 1 July 1993–30 September 1993.** Yoon, R.H.; Luttrell, G.H. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). [1993]. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91164. Order Number DE94013057. Source: OSTI; NTIS; GPO Dep.

A novel technique for selectively coagulating and separating coal from dispersed mineral matter has been developed at Virginia Tech. The process, known as Selective Hydrophobic Coagulation (SHC), has been studied under the sponsorship of the U.S. Department of Energy since 1986. The SHC process differs from oil agglomeration, shear flocculation, polymer flocculation, and electrolytic coagulation processes in that it does not require reagents or additives to induce the formation of coagula. Often, simple pH control is all that is required to (i) induce the coagulation of coal particles, and (ii) effectively disperse particles of mineral matter. When the coal is superficially oxidized, a small dosage of reagents may be used to promote coagulation. During the past quarter, work was completed on the prediction of optimum conditions for the SHC process using the extended DLVO equation (Subtask 2.3). In addition, the evaluation of the lamella thickener for separating hydrophobic coagula from dispersed mineral matter was completed. Work is now underway to complete the evaluation of other separation devices including a vacuum filter, flotation column and centrifuge (Subtask 3.3).

20656 (DOE/PC/91281–T10) **Low severity coal liquefaction promoted by cyclic olefins: Quarterly report, January–March 1994.** Curtis, C.W. Auburn Univ., AL (United States). Dept. of Chemical Engineering. [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91281. Order Number DE94013467. Source: OSTI; NTIS; GPO Dep.

Previous research has suggested that using a more effective hydrogen donor solvent in the low severity coal liquefaction reaction improves coal conversion. In order to understand the results of these methods, both independently and combined, a factorial experiment was designed. Pretreating coal with hydrochloric and sulfurous acid solutions in both water and methanol is compared with pretreating coal using only methanol and with no pretreatment. The effects of these pretreatments on coal liquefaction behavior are contrasted with the ammonium acetate pretreatment. Within each of these, individual reactions are performed with the hydroaromatic 1,2,3,4-tetrahydronaphthalene (tetralin, TET) and the cyclic olefin 1,4,5,8-tetrahydronaphthalene (isotetralin, ISO). The final aspect of the factorial experiment is the comparison of Wyodak subbituminous coal (WY) from the Argonne Premium Sample Bank and Black Thunder subbituminous coal (BT) provided by Amoco. Half of the reactions in the matrix have now been completed. In all but one case, Black Thunder-HCl/H_2O, the ISO proved to be more reactive than TET. After the other four reactions using this combination are complete, the average conversion may be greater with the cyclic olefin. The second part of this paper describes the current and future work with Fourier transform infrared spectroscopy. The objective of this work is to determine the kinetics of reaction of isotetralin at high temperatures and pressures. This quarter combinations of three products typically produced from isotetralin were used in spectral subtraction.

20657 (DOE/PC/91287–T1) **Supercritical thermodynamics of sulfur and nitrogen species: Quarterly progress report, January 1, 1994–March 31, 1994.** Eckert, C.A. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91287. Order Number DE94013470. Source: OSTI; NTIS; GPO Dep.

Significant opportunity exists for the application of supercritical fluid (SCF) technology to coal processing, both for pretreatment of high sulfur coals, as well as liquefaction and treatment of coal liquids. Supercritical fluids are attractive solvents for a variety of coal processing applications because of their unusual solvating and mass transfer properties. Solubility studies have been carried out for a number of model coal and coal-liquid compounds, primarily in pure supercritical fluids. We are extending this database of model coal compound equilibria using modern techniques that have the advantage of being much more rapid than traditional techniques. Cosolvent effects on solubility are being investigated over a variety of solvent properties. In addition, specific molecular interactions are being investigated through spectroscopic techniques. The resulting data are being used to develop a chemical-physical equation of state (EOS) model of SCF solution with meaningful parameters. The equation of state will be used to predict solubility behavior, which will permit the design and tailoring of SCF cosolvent systems for specific coal processing applications.

20658 (DOE/PC/91304–T9) **Low severity upgrading of F-T waxes with solid superacids: Quarterly report, December 1, 1993–February 28, 1994.** Tierney, J.W.; Wender, I. Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91304. Order Number DE94013468. Source: OSTI; NTIS; GPO Dep.

Work in the proceeding quarter focussed on the kinetic modeling of isomerization and hydrocracking reactions of long-chain paraffins over a $Pt/ZrO_2/SO_4$ catalyst. The model is based on a simplified reaction network. The effects of hydrogen pressure and platinum loading on catalytic activity of $Pt/ZrO_2/SO_4$ were included in the kinetic model. This model, which describes the lumping products as a function of time, was fitted with experimental data obtained from a batch reactor. The predicted product distribution agrees with the experimental data within $\pm$ 10%. In addition, following up previous work on the alkylation of aromatics in the presence of paraffinic compounds, the $Pt/ZrO_2/SO_4$ catalyzed reaction of neopentylbenzene was carried out. This compound cannot form an olefinic bond and was investigated to obtain evidence on the possibility of the alkylation of benzene proceeding via olefinic intermediates. It appears that the reaction proceeds by direct protonation of paraffinic structures.

20659 (DOE/PC/92122–T4) **Novel bimetallic dispersed catalysts for temperature-programmed coal liquefaction: Technical progress report, July–September 1993.** Schmidt, E.; Song, C.; Schobert, H.H. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. Jan 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92122. Order Number DE94013063. Source: OSTI; NTIS; GPO Dep.

Development of new catalysts is a promising approach to more efficient coal liquefaction. It has been recognized that dispersed catalysts can be superior to supported catalysts for primary liquefaction of coals, because the control of initial coal dissolution or depolymerization requires intimate contact between the catalyst and coal. The primary objective of this research is to explore novel bimetallic dispersed catalysts from heterometallic molecular precursors, that can be used in low concentrations but exhibit high activity for efficient hydroliquefaction of coals under temperature-programmed conditions. This quarterly report describes the preparation of two precursors. The first is a heterometallic complex consisting of two transition metals, Mo and Ni, and sulfur in a single molecule synthesized. The second is a thiocubane type cluster consisting of iron and sulfur.

20660 (DOE/PC/92122–T5) **Novel bimetallic dispersed catalysts for temperature-programmed coal liquefaction: Technical progress report, October–December 1993.** Schmidt, E.; Kirby, S.; Song, Chunshan; Schobert, H.H. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. Apr 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92122. Order Number DE94013064. Source: OSTI; NTIS; GPO Dep.

Development of new catalysts is a promising approach to more, efficient coal liquefaction. It has been recognized that dispersed catalysts can be superior to supported catalysts for primary liquefaction of coals, because the control of initial coal dissolution or depolymerization requires infinite contact between the catalyst and coal. The primary objective of this research is to explore the potential of bimetallic dispersed catalysts from heterometallic molecular precursors in their use in model compound liquefaction reactions. This quarterly report describes the use of three precursors in model compound reactions. The first catalyst is a heterometallic complex consisting of two transition metals, Mo and Ni, and sulfur in a single molecule. The second is a thiocubane type complex consisting of cobalt, molybdenum and sulfur. The third is a thiocubane type cluster consisting of iron and sulfur and the fourth, the pure inorganic salt ammonium tetrathiomolybdate (ATM). It was found that the structure and the ligands in the model complexes affect the activity of the resulting catalyst significantly. The optimum reaction at a pressure of 6.9 MPa hydrogen gas varied for different catalysts. The bimetallic catalysts generated in situ from the organometallic precursor are more active than monometallic catalysts like ATTM and the thiocubane type cluster Fe_4. Main products are hydrogenated phenanthrene derivatives, like DBP, THP, sym-OHP, cis- and trans-unsym-OHP with minor isomerization products such as sym-OHA. Our results indicate that other transition metal and ligand combinations in the organometallic precursors and the use of another model compound could result in substantially higher conversion activity.

20661 (DOE/PC/92152–T8) **The physics of coal liquid slurry atomization: Technical progress report, 1993 year.** Carnegie-Mellon Univ., Pittsburgh, PA (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92152. Order Number DE94013210. Source: OSTI; NTIS; GPO Dep.

The stability of turbulent columns of liquid injected into a quiescent environment has been studied. Turbulence decay along Newtonian jets was investigated along with the effects of turbulence on the resulting droplet size distributions after breakup. Disintegration of liquid jets injected into a high-velocity gas stream has also been studied. Newtonian and non-Newtonian liquids were studied with particular emphasis on the non-Newtonian rheological characteristics. Determination was made of the extent that the addition of high molecular weight polymer to liquids changes the breakup process. Shear thinning, extension thinning and extension thickening fluids were investigated. The non-Newtonian viscosities were measured over rive decades of shear rates γ for 12 solutions of polymeric materials. By using the die-swell technique, the first normal stress difference N_1 was determined for all solutions. By using the contraction flow technique, the extensional viscosity levels were determined for the most viscous solutions. The near field produced by a co-axial airblast atomizer was investigated using the phase Doppler particle analyzer. The classical wave mechanism and empirical models reported for air-blast atomization of low viscosity liquid were shown to be applicable to air-blast atomization of viscous non-Newtonian liquids. The theoretical basis of several models which give the best fit to the experimental data for air-blast atomization of non-Newtonian liquids was addressed.

20662 (DOE/PC/92521–T127) **Development of a use for Illinois coal concentrates for slurry fed gasifiers: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Khan, L.A. (Illinois State Geological Survey, Champaign, IL (United States)); Lytle, J.M.; Khan, S.; At-Taras, M.; Ehrlinger, H.P. III. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012515. Source: OSTI; NTIS; GPO Dep.

The purpose of this project is to test concentrates made from preparation plant fines as to their amenability as feed for slurry fed,

slagging, entrained-flow gasifiers. During the current reporting period, waste slurry samples were obtained from the washing plants associated with surface mining, underground mining from which the fines are not treated, underground mining from which a flotation concentrate is made from the washer plant waste fines, and from a tailing pile associated with one of the washing plants which had been deposited for over five years. Column flotation testing was conducted on representative samples of several of these. Using a typical flotation reagent requirement of kerosene and MIBC several tests showed outstanding results when the feed rate was kept at the nominal rate of 10 pounds per hour as suggested by the Deister Concentrator Company. The most encouraging test was conducted on waste fines from the surface plant. While the ash content in the clean coal concentrate was higher than expected, the calorific content in the tailing was 422 BTU/pound, which was at least twice as low as any tailings produced either in the laboratory or in plants during the last ten years of coal flotation research. In this same test 96.9% of the BTU's were concentrated in the flotation product and 80.3% of the ash reported in the flotation tailing. Flotation results of the material which had been impounded for an extended period were encouraging as 67.7% of the BTU's were concentrated in a product which contained 12,762 BTU/pound.

20663 (DOE/PC/92521–T128) **Illinois coal/RDF coprocessing to produce high quality solids and liquids: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Hippo, E.J. (Southern Illinois Univ., Carbondale, IL (United States)); Palmer, S.R.; Blankenship, M. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012555. Source: OSTI; NTIS; GPO Dep.

It is the aim of this study to provide information pertinent to the development of a coal/RDF pyrolysis process capable of economically creating valuable products from high sulfur Illinois coal. This project will be carried out in a systematic manner. First, samples will be properly selected prepared, preserved and characterized. Then coals, various plastics, cellulose, and a high quality RDF will be pyrolyzed, steam pyrolyzed, hydro-pyrolyzed, and liquefied at various conditions. Next, blends of coal with various RDF components will be reacted under the same conditions. From this work synergistic effects will be identified and process parametric studies will be conducted on the appropriate mixtures and single components. Product quality and mass balances will be obtained on systems showing promise. Preliminary pyrolysis work will be conducted on a TGA. Over 100 microreactor experiments have been performed and the acquisition of products for analysis has been achieved. Interactions occur between 400–450°C. The use of higher temperatures should be avoided if liquids are the desired product. Although these results are preliminary they are also very encouraging.

20664 (DOE/PC/92521–T132) **Sulfur removal in advanced two-stage fluidized-bed combustion: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Abbasian, J. (Inst. of Gas Technology, Chicago, IL (United States)); Hill, A.H.; Wangerow, J.R.; Rue, D.M. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012559. Source: OSTI; NTIS; GPO Dep.

The objective of this study is to obtain data on the rates of reaction between, hydrogen sulfide (H_2S) and uncalcined calcium-based sorbents under operating conditions relevant to first stage (carbonizer) of Advanced Two-Stage Pressurized Fluidized-Bed Combustors (PFBC). In these systems the CO_2 partial pressure in the first stage generally exceeds the equilibrium value for calcium carbonate decomposition. Therefore, removal of sulfur compounds takes place through the reaction between H_2S and calcium carbonate. To achieve this objective the rates of reaction between hydrogen sulfide and uncalcined calcium-based sorbents will be determined by conducting tests in pressurized thermogravimetric analyzer (TGA) and high-pressure/high-temperature fluidized-bed reactor (HPTR) units. The effects of sorbent type, sorbent particle size, reactor temperature and pressure, and CO_2 and H_2S partial pressures on the sulfidation reaction rate will be determined. During this quarter, the high-pressure thermogravimetric analyzer (HPTGA) unit was installed and the shakedown process was completed. Several tests were conducted in the HPTGA unit to establish the operating procedure and the repeatability of the experimental results. Sulfidation by conducting the baseline sulfidation tests. The results are currently being analyzed.

20665 (DOE/PC/92521–T137) **An attrition-resistant zinc titanate sorbent for sulfur: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Swisher, J.H. (Southern Illinois Univ., Carbondale, IL (United States)); O'Brien, W.S.; Gupta, R.P. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012564. Source: OSTI; NTIS; GPO Dep.

In the continuing search for good sorbent materials to remove sulfur from hot, coal-derived gases, zinc titanate sorbents have shown great promise. The objective of this project is to extend the effort started last year on increasing the strength and durability of zinc titanate sorbents with little or no loss in chemical reactivity.. The principle is to contain Zn_2TiO_4 in a structural matrix of excess TiO_2. A fluidized bed test was completed this quarter on the second promising formulation selected last year. The results showed its chemical reactivity to increase with each of the ten test cycles. While the breakthrough times were somewhat shorter than for the first formulation tested, the second formulation's attrition resistance was outstanding. On another task in the project, experiments are underway to develop improved sorbent regeneration procedures.

20666 (DOE/PC/92521–T138) **Development of novel copper-based sorbents for hot-gas cleanup: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Abbasian, J. (Institute of Gas Technology, Chicago, IL (United States)); Hill, A.H.; Flytzani-Stephanopoulos, M.; Li, Zhijiang. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012565. Source: OSTI; NTIS; GPO Dep.

The objective of this investigation is to evaluate two novel copper-based sorbents, namely copper-chromium and copper-cerium, for their effectiveness in removing hydrogen sulfide from fuel gas in the temperature range of 650° to 850°. Such high temperatures will be required for the new generation of gas turbines (inlet >750°C) in Integrated Gasification Combined Cycle (IGCC) systems. The effect of pre-reduction with H_2, in the presence of H_2O on the performance of the sorbents in cyclic sulfidation/regeneration, was studied in a thermogravimetric analyzer (TGA) and in a fixed-bed reactor at 750°C. The results of the TGA tests indicate that pre-reduction of the sorbents is very fast in either 10% or 30% H_2. Without sorbent pre-reduction, sulfidation consists of two-stages, a reduction-dominating and a sulfidation-dominating stage. Sulfidation apparently takes place before reduction is complete. During regeneration some copper/cerium sulfates may have formed and Cu_2O may have formed in addition to CuO. The fixed-bed reactor tests show that at 750°C: (1) prereducing the $CuO-Cr_2O_3$ with H_2 does not effect the reactivity of the sorbent towards H_2S at either the high or low H_2 feed gas concentrations and (2) when 30% H_2 was used during sulfidation of either sorbent, the first H_2S breakthrough occurs earlier than when 10% H_2 was used.

20667 (DOE/PC/92521–T144) **Production of Illinois base compliance coal using enhanced gravity separation: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Paul, B.C. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Mining Engineering); Honaker, R.Q. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012571. Source: OSTI; NTIS; GPO Dep.

Illinois Basin coal often contains a significant portion of finely dispersed pyrite. Most of the free pyrite particles exist in the fine size fractions, which are generally treated using froth flotation. An inherent problem of their froth flotation process is the inefficient treatment of middling particles containing a small amount of coal

on their surface. On the other hand, gravity-based processes can effectively remove middling particles containing only a small amount of coal. Falcon Concentrators Inc. and Knelson Gold Concentrators Inc. have developed full-scale, enhanced gravity separators for the treatment of heavy minerals. This project will evaluate the potential of using these concentrators to de-ash and de-sulfurize Illinois coal fines. During this reporting period, sample characterization was completed and initial tests were conducted using the Falcon Concentrator. A 28 mesh × 0 flotation feed sample was collected from a local coal preparation plant treating the Illinois No. 6 seam coal. This sample was characterized on a size-by-size basis for sulfur, ash, and BTU content. A release analysis was conducted to determine the separation performance that can be achieved by froth flotation. The initial Falcon Concentrator tests were conducted using both water and the flotation feed to provide a preliminary knowledge base for its operational characteristics.

20668 (DOE/PC/92521–T145) **Reactivity of target compounds for chemical coal desulfurization: Technical report, 1 December 1993–28 February 1994.** Buchanan, D.H. (Eastern Illinois Univ., Charleston, IL (United States)); Amin, M.; Cunningham, R.; Galyen, J. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012572. Source: OSTI; NTIS; GPO Dep.

This project seeks to identify representative organosulfur compounds which are removed by coal desulfurization reactions. Demineralized coals from the Illinois Basin Coal Sample Program are solvent extracted and the extracts fractionated to separate and concentrate organosulfur compounds for analysis by Gas Chromatography/Mass Spectroscopy. After sulfur compounds are characterized, the parent extracts will be subjected to reactions previously shown to reduce the organic sulfur content of Illinois coals, fractionated and again analyzed for organosulfur content to determine which compounds reacted during the chemical treatment. The original coal will be subjected to chemical desulfurization, extraction, fractionation and analysis in order to correlate changes in organic sulfur content of the coal with reactions of specific sulfur compounds. These compounds can thus be reliably considered as target molecules for the next generation of desulfurization processes. During this quarter, work continued on developing efficient methods to isolate and analyze sulfur-rich coal extract fractions by GC/MS. Since only relatively non-polar compounds can be analyzed, pyridine extracts must be fractionated. Direct extraction of several coals with toluene is quicker but did not give as much toluene soluble material as fractionation of pyridine extracts and is thus not suitable for preparation of representative analytical samples. The authors observe that most IBC sample program coals contain elemental sulfur due to oxidation of pyrite. There is less elemental sulfur in IBC-101 than in other Herrin coals. This coal was washed in a preparation plant to reduce pyrite concentration. Since elemental sulfur slowly reacts to produce organosulfur compounds in coal during storage or handling, this suggests that early removal of pyrite can reduce formation of these hard to remove compounds.

20669 (DOE/PC/92521–T146) **Molecular biological enhancement of coal biodesulfurization: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Kilbane, J.J. II (Institute of Gas Technology, Chicago, IL (United States)). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012573. Source: OSTI; NTIS; GPO Dep.

IGT has developed a microbial culture of Rhodococcus rhodochrous, IGTS8, that is capable of specifically cleaving carbon-sulfur bonds in a range of organosulfur model compounds and is capable of removing organic sulfur from coal and petroleum. Although IGTS8 possesses the ability to specifically remove organic sulfur from coal, a major research need is to develop improved strain's of microorganisms that possess higher levels of desulfurization activity and therefore wall permit more favorable biodesulfurization process conditions: faster rates, mare complete removal, and smaller reactor size. Strain improvement is the single most important aspect to the development of a practical coal biodesulfurization process and accordingly is the focus of research in this project. Several possible strong promoters have been isolated and are in the process of being analyzed. When these promoters have been characterized for inducibility, strength, transcriptional start sites and other physical properties, they will be placed in front of the desulfurization genes and expression will be monitored. Improved promoter probe vectors have been constructed, allowing a conclusive screen of all putative Rhodococcus promoters. With the improved methodologies in the handling of Rhodococcus RNA, we have begun to gauge promoter expression using Northern blots. During this quarter we have constructed and successfully used a promoter probe vector using the β-galactosidane gene from E. coli. A chromosomal promoter library was constructed upstream from the β-galactosidase gene. Over 200 colonies were isolated that yielded β-galactosidase activity.

20670 (DOE/PC/92521–T150) **Washability of trace elements in product coals from Illinois mines: Technical report, 1 December 1993–28 February 1994.** Demir, I. (Illinois State Geological Survey, Champaign, IL (United States)); Ruch, R.R.; Harvey, R.D.; Steele, J.D.; Khan, S. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012577. Source: OSTI; NTIS; GPO Dep.

The existing trace element washability data on Illinois coals are based on float-sink methods, and these data are not applicable to modern froth flotation or column flotation processes. Particularly, there is a lack of washability data on samples from modern preparation plants, as well as other product (as-shipped) coals. The goal of this project is to provide the needed trace element washability data on as-shipped coals that were collected during 1992–1993 from Illinois mines. During the second quarter, froth flotation/release analysis (FF/RA) tests on 34 project samples were completed at −100, −200, and −400 mesh particle sizes. Products from the FF/RA tests were analyzed for ash, moisture, and some for total S and heating value (BTU), and the resulting data are being used to construct a series of washability curves. For example, these curves can show variation in BTU or combustible recovery as a function of the amount of ash or S rejected. Composite samples, each having 80% of the total BTU (or combustibles), were prepared for the −100 and −200 mesh FF/RA tests and submitted for trace element analysis. The composite samples for the −400 mesh FF/RA tests will be submitted soon, and the analytical results are expected to be available in 3–4 months. The trace element data on the composite samples will indicate the potential for the removal of each element from the coals at the chosen flotation conditions and particle sizes.

20671 (DOE/PC/92537–T4) **Novel catalysts for upgrading coal-derived liquids: Quarterly technical progress report, 1 October 1993–31 December 1993.** Thompson, L.T.; Savage, P.E.; Briggs, D.E. Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering. 31 Dec 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92537. Order Number DE94011781. Source: OSTI; NTIS; GPO Dep.

The principal objective of this research is to evaluate the hydrotreatment properties of γ-Al_2O_3 supported Mo oxynitride and oxycarbide catalysts. This information will be used to assess the potential of these materials for use as commercial catalysts for hydrotreating coal-derived liquids. During this quarter, the authors evaluated the catalytic properties of a series of supported molybdenum nitride catalysts. These catalysts were prepared in the laboratory for comparison with the supported molybdenum oxynitrides. Pyridine hydrodenitrogenation (HDN) was used as the test reaction.

20672 (DOE/PC/92545–6) **Fischer Tropsch synthesis in supercritical fluids: Quarterly technical progress report, January 1, 1994–March 31, 1994.** Akgerman, A.; Bukur, D.B. Texas A and M Univ., College Station, TX (United States). Dept. of Chemical Engineering. [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92545. Order Number DE94013491. Source: OSTI; NTIS; GPO Dep.

We have successfully completed our first Fischer-Tropsch synthesis test with propane as the supercritical fluid. The catalyst

activity and hydrocarbon product distribution under the SFT conditions were similar to those obtained during the normal Fischer-Tropsch synthesis, however, the use of supercritical fluid resulted in higher selectivity of the primary products. The use of a new trap with larger inside surface area, improved the collection of liquid products and thus enabling us to achieve better atomic and overall mass balance closures. This has also improved results from on-line GC analysis. However, further improvement are needed to achieve more stable and reproducible gas phase analysis, including the capability of the on-line analysis of the feed gas (mixture of hydrogen, carbon monoxide and propane).

20673 (DOE/PC/93224–T2) **Large scale solubilization of coal and bioconversion to utilizable energy: Quarterly technical progress report, January-March 1994.** Mishra, N.C. South Carolina Univ., Columbia, SC (United States). Dept. of Biological Sciences. [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93224. Order Number DE94013068. Source: OSTI; NTIS; GPO Dep.

In order to develop a system for large scale coal solubilization and its bioconversion to utilizable fuel, the authors plan to clone the genes encoding Neurospora protein that facilitate depolymerization of coal. They also plan to use desulfurizing bacteria to remove the sulfur in situ and use other microorganisms to convert biosolubilized coal into utilizable energy following an approach utilizing several microorganisms (Faison). In addition the product of coal solubilized by fungus will be characterized to determine their chemical nature and the mechanism of reaction catalyzed by fungal product during in vivo and in vitro solubilization by the fungus or purified fungal protein.

20674 (OCDO–94012358) **The use of ethanol to remove sulfur from coal: Final report, September 1991–December 1992; Revision.** Savage, R.L.; Lazarov, L.K.; Prudich, M.E.; Lange, C.A.; Kumar, N. Ohio Coal Development Office, Columbus, OH (United States); Ohio Coal Research Center, Athens, OH (United States). 10 Mar 1994. 41p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The initial technical goal in the project was to develop a chemical method for the cost effective removal of both inorganic and organic sulfur from Ohio coals. Verifying and using a process of reacting ethanol vapors with coal under conditions disclosed in U.S. Patent 4,888,029, the immediate technical objectives were to convert a small scale laborative batch process to a larger scale continuous process which can serve as the basis for commercial development of the technology. This involved getting as much information as possible from small scale batch autoclave or fluid bed laboratory reactors for use in pilot plant studies. The laboratory data included material balances on the coal and sulfur, temperature and pressure ranges for the reaction, minimum reaction times at different conditions, the effectiveness of different activators such as oxygen and nitric oxide, the amount and nature of by-products such as sulfur dioxide, hydrogen sulfide and acetaldehyde, the effect of coal particle size on the speed and completeness of the reaction, and the effectiveness of the reaction on different Ohio coals. Because the laboratory experiments using the method disclosed in U.S. 4,888,029 were not successful, the objective for the project was changed to develop a new laboratory process to use ethanol to remove sulfur from coal. Using copper as a catalyst and as an H_2S scavenger, a new laboratory procedure to use ethanol to remove sulfur from coal has been developed at Ohio University and a patent application covering this process was filed in March, 1993. The process is based on the use of copper as a catalyst for the dehydrogenation of ethanol to produce nascent hydrogen to remove sulfur from the coal and the use of copper as a scavenger to capture the hydrogen sulfide formed from the sulfur removed from coal.

20675 (PNL-SA–23342) **Nano-crystalline powders and suspensions generated using a flow-through hydrothermal process, Part 2: Applications.** Darab, J.G.; Buehler, M.F.; Linehan, J.C.; Matson, D.W. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940411–30: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013436. Source: OSTI; NTIS; GPO Dep.

Ultra-fine, nano-crystalline six-line ferrihydrite ($5Fe_2O_39H_2O$) and cubic zirconia (ZrO_2) powders have been produced using the Rapid Thermal Decomposition of precursors in Solution (RTDS) technology. Nano-crystalline RTDS six-line ferrihydrite powder used as an in situ precursor for first-stage direct coal liquefaction catalysts increased the liquefied products from Blind Canyon Seam coal by 22% absolute over thermal background at 350°C. Initial sintering studies performed on nano- crystalline RTDS ZrO_2 powder have also been presented and compared to predictions made from theories derived for micro- crystalline powders.

20676 (SAND–94-1140C) **Alternate routes for the production of fuels from coal and natural gas.** Gray, D. (Mitre Corp., McLean, VA (United States)); Tomlinson, G.; ElSawy, A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940813–7: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94012728. Source: OSTI; NTIS; GPO Dep.

Almost all transportation worldwide is powered by high energy-density liquid hydrocarbon fuels produced from crude oil. Transportation fuels currently use over 50 percent of total world petroleum demand of 66 million barrels per day. Prior MITRE studies indicate that crude oil supply will become severely limited after the year 2030 as increasing world energy demand, driven by population growth and economic development, depletes oil resources. If conventional liquid hydrocarbon fuels that can use existing production and distribution infrastructures are still needed for transportation in the future, then alternate sources of these fuels will have to be utilized. Two such sources are natural gas and coal. Natural gas reserves worldwide are expected to last well into the 21st century, and coal resources are enormous. This paper examines the technologies for producing environmentally superior liquid transportation fuels from coal and natural gas using modern conversion technologies. Estimates of the costs of fuels from these sources are given, and the potential environmental impacts of these fuels are examined.

20677 (SAND–94-1160C) **Comparison of nickel molybdenum hydrous metal oxides with commercial catalysts for HDS/HDN of coal liquids.** Lott, S.E.; Gardner, T.J.; McLaughlin, L.I.; Oelfke, J.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940813–8: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94013346. Source: OSTI; NTIS; GPO Dep.

Improved efficiency in direct coal liquefaction processes can be obtained by developing catalysts with better activity, selectivity, and life. In previous exploratory research at Sandia National Laboratories, catalysts prepared via hydrous metal oxide (HMO) ion exchangers have been shown to have potential for application to a number of reactions associated with the conversion of coal to liquid fuels. In the present effort, one member of this class of catalysts, hydrous titanium oxide (HTO), has been used to develop catalysts for hydrodesulfurization (HDS) and hydrodenitrogenation (HDN) of coal liquids. For HYD of pyrone, unsupported NiMoHTO catalysts performed better than commercial benchmark catalysts on either a catalyst weight or active metals basis. In a side-by-side comparison of supported NiMoHTO catalysts with commercial counterparts, the supported NiMoHTO catalysts outperformed the Shell 324 and Amocat 1C catalysts for HYD of pyrene. For HDS/HDN of coal liquids, the supported and bulk forms of the NiMoHTO catalysts equaled the performance of the commercial catalysts at 500, 1000, and 1500 psig while containing less active metals. Possible reasons for the high activity of the NiMoHTO catalysts are a high dispersion of the active MoS_2 phase and a high acidity of the bulk NiMoHTO.

0105 Products and By-Products

20678 (DOE/PC/92521–T133) **Coal combustion under conditions of blast furnace injection: [Quarterly] technical report, 1 December 1993–28 February 1994.** Crelling, J.C. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Geology). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012560. Source: OSTI; NTIS; GPO Dep.

A potentially new use for Illinois coal is its use as a fuel injected into a blast furnace to produce molten iron as the first step in steel production. Because of its increasing cost and decreasing availability, metallurgical coke is now being replaced by coal injected at the tuyere area of the furnace where the blast air enters. The purpose of this study is to evaluate the combustion of coal during the blast furnace injection process and to delineate the optimum properties of the feed coal. This proposal is a follow-up to one funded for the 1992–1993 period. It is intended to complete the study already underway with the Armco Inc. Steel Company and to initiate a new cooperative study along somewhat similar lines with the Inland Steel Company. The results of this study will lead to the development of a testing and evaluation protocol that will give a unique and much needed understanding of the behavior of coal in the injection process and prove the potential of Illinois coals for such use. During this quarter a sample of the feed coal that is being used for injection into the No. 7 Blast Furnace of Inland Steel has been analyzed petrographically and compared to both the Herrin No. 6 coal and Armco feed coal. Additional characterization is underway and an advanced program of pyrolysis and reactivity testing has been initiated.

20679 (DOE/PC/92521–T136) **Production and use of activated char for combined SO_2/NO_x removal: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Lizzio, A.A. (Illinois State Geological Survey, Champaign, IL (United States)); DeBarr, J.A.; Rostram-Abadi, M.; Rood, M.J. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012563. Source: OSTI; NTIS; GPO Dep.

During this reporting period, a thermogravimetric technique was developed to determine the kinetics of SO_2 adsorption on a series of chars prepared from IBC-102 coal. Also, a temperature programmed desorption (TPD) method was developed to determine the nature and extent of carbon-oxygen (C-O) complexes formed on the surface of the char. An attempt was made to relate this information to observed SO_2 adsorption behavior. An IBC-102 char prepared with an N_2-BET surface area of 10 m^2/g adsorbed significantly less SO_2 than chars prepared with surface areas > 200 m^2/g. However, for chars with surface areas > 200 m^2/g, the amount of available surface area was not as important as the chemistry of the surface. A steam activated char adsorbed the most SO_2, comparable to the amount adsorbed by a commercial activated carbon. TPD performed on the steam activated char revealed the presence of CO-forming C-O complexes which were basic in nature. The other chars all contained significant amounts of more acidic CO_2-forming complexes. Because SO_2 is an acid gas, a carbon adsorbent with a basic surface should adsorb more SO_2. To enhance SO_2 adsorption, a novel char preparation method was devised to 2 create a basic surface with up to ten times more CO-forming C-O complexes than formed by steam activation.

0106 Properties and Composition

Refer also to citation(s) 20609, 20612, 20631, 20649, 20667, 20712, 20730, 22431, 22432

20680 (CONF-900554–1) **Design and calibration of a CO_2-laser nephelometer to measure the radiative properties of coal particles.** Bush, M.B.; D'sa, D.A.; Manickavasagam, S.; Menguec, M.P. Kentucky Univ., Lexington, KY (United States). Dept. of Mechanical Engineering. [1990]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-87PC79916. From Spring technical meeting of the central states section of the Combustion Institute: combustion fundamentals and applications; Cincinnati, OH (United States); 20-22 May 1990. Order Number DE94011691. Source: OSTI; NTIS; GPO Dep.

In is paper, we will discuss the design and calibration of a CO_2-laser nephelometer for angular light scattering measurements to determine the effective radiative properties of pulverized-coal particles in a non-flame, planar system in-situ. A nephelometer is an instrument used for angular detection of scattered light incident on a cloud of particles. Its essential elements include a collimated light source and an arm which houses light collection optics and detectors. The arm can be rotated to record the angular scattered intensity distribution. A major problem when conducting experiments of this nature is that the intensity of the scattered light by pulverized-coal particles at angles other than the forward scattering direction can be as much as two to three orders of magnitude lower than the intensity at angles close to $\theta = O^o$. This effect is more pronounced for larger size parameters. In order to have sufficiently strong signals at a wide range of angles, a 50 watt CO_2-laser operating at 10.6 μm is used in the experiments.

20681 (DOE/MC/10637–3663, pp. Paper 5, 196) **Combustion inorganic transformations.** Zygarlicke, C.J. (Univ. of North Dakota, Grand Forks, ND (United States)); Benson, S.A.; Toman, D.L.; Steadman, E.N.; Brekke, D.W.; Erickson, T.A.; Hurley, J.P. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The work that was proposed this year under Task 1 was: (1) Rigorous testing of the present CCSEM analysis, which includes the use of mineral standards and well-characterized coals. (2) Software and hardware development to allow for stage automation, multiple threshold capabilities, and data manipulation. (3) Eliminating size biases associated with irregularly shaped grains and sample preparation. (4) Modification of existing software to determine juxtaposition of mineral grains. (5) Developing software that will graphically represent the elemental composition of mineral and ash components. All of the proposed goals listed above were accomplished in full except for No. 3, which was completed for the most part; however, questions remain as to the type of correction factor(s) needed for coal minerals. Work will continue into the next year to correctly evaluate size biases of coal minerals by CCSEM.

20682 (DOE/MC/10637–3703, pp. Paper 18, 18) **Sulfur forms in coal.** Hawthorne, S.B. (Univ. of North Dakota, Grand Forks, ND (United States)); Timpe, R.C.; Louie, P. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The accurate and precise analysis of a solid material, such as coal, requires that the analytical method utilize energy, solvent, of reagent that can effectively permeate the matrix and contact the element of interest. Physicochemical barriers preventing such contact have proven formidable when sulfur analysis of solid coal by conventional technologies is attempted. Analysis of coal for sulfur by volatilization of sulfur moieties is limited by their volatilities and vapor transport through the matrix, and liquid extraction of those moieties is limited by conventional solubility and permeability. Chemical derivatization for ^{13}C nuclear magnetic resonance (NMR) spectroscopy is reagent-transport limited, ^{33}S NMR is limited by absorption bandwidth, and x-ray techniques are limited to surface analysis by the inability to penetrate the solid more than a few angstroms. Given these drawbacks, a technique that would allow solvent penetration into the entire sample and dissolution of the sulfur species, with the ability to obtain those species intact in a form that can be identified and quantified by conventional analytical methods, would advance sulfur science immeasurably.

20683 (DOE/MC/30097–3716) **Resource characterization and residuals remediation, Task 1.0: Air quality assessment and control, Task 2.0: Advanced power systems, Task 3.0: Advanced fuel forms and coproducts, Task 4.0.** Hawthorne, S.B. (and others); Timpe, R.C.; Hartman, J.H. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental

Research Center. Feb 1994. 364p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-93MC30097. Order Number DE94004104. Source: OSTI; NTIS; GPO Dep.

This report addresses three subtasks related to the Resource Characterization and Residuals Remediation program: (1) sulfur forms in coal and their thermal transformations, (2) data resource evaluation and integration using GIS (Geographic Information Systems), and (3) supplementary research related to the Rocky Mountain 1 (RM1) UCG (Underground Coal Gasification) test program.

20684 (DOE/MT/92019–5) **Effect of coal beneficiation process on rheology/atomization of coal water slurries: Quarterly progress report, November 1, 1993–January 31, 1994.** Ohene, F. Grambling State Univ., LA (United States). Dept. of Chemistry. [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92MT92019. Order Number DE94014003. Source: OSTI; NTIS; GPO Dep.

The atomization study began with simulated fluids-(Mixtures of glycerine-water mixtures or corn syrup-water mixtures). This was done to minimize the experimental variables, optimize the experimental conditions for subsequent CWS atomization studies and also, simplify the analysis. The atomization data obtained for the simulated fluids are as shown in Table 1 and 2. The Air/Fuel ratio was varied from 0.12–0.40 in this study. variation of SMD as a Function of Viscosity. The SMD of glycerine-water mixtures at high Air/Fuel and low Air/Fuel data are plotted in Figures 5 and 6. The data show that at high Air/Fuel ratio, there is no significant change of the SMD as the viscosity is varied. However, at low Air/Fuel ratio the SMD shows a strong dependence on the viscosity. This is due to the fact that entrainment losses become more severe as A/F increases, In the high A/F regime, there is very little variation between the SMD and the viscosity of the glycerine-water solutions. This is probably due to the fact that the relative velocity between the droplets and the air is very high and this produces high pressure forces on the droplets to the same extent. Considerable dispersion of the droplets was also observed at high A/F ratios. This effect is minimized in the low A/F regime. Figures 5–8 show plots os SMD as a Function of Air/Fuel ratio. The plot show a linear dependence of SMD on the air to Fuel ratio. A fit of the experimental data to equation 1 in order to determine the necessary coefficients will be reported during the next quarter.

20685 (DOE/PC/89663–T13) **Development of a coal quality expert: [Fourth quarterly] technical progress report No. 15, [October 1–December 31, 1993].** CQ, Inc., Homer City, PA (United States); ABB/Combustion Engineering, Inc., Windsor, CT (United States). 14 Feb 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89663. Order Number DE94013071. Source: OSTI; NTIS; GPO Dep.

During the past quarter, tasks 4, 5, and 6 were active. Under Task 4, work continued on the King, Gaston, and Brayton Point field test reports with completion and release expected in the Spring of 1994. Tasks 5 and 6 activities were directed at design and development of CQE base classes and objects, continued formulation, testing, and integration of CQE algorithms and submodels, and the development of the user interface prototype.

20686 (DOE/PC/91296–10) **Advanced NMR-based techniques for pore structure analysis of coal: Quarterly report No. 10, January 1, 1994–March 31, 1994.** Smith, D.M. New Mexico Univ., Albuquerque, NM (United States). Center for Micro-Engineered Ceramics. [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91296. Order Number DE94013492. Source: OSTI; NTIS; GPO Dep.

In the present quarter, results from ^{129}Xe NMR experiments were made available that allowed the determination of the mean free path of a Xenon molecule within the pores of the material. The chemical shift at various loadings of Xenon was determined and the shift at zero loading was obtained by extrapolating the data to zero pressure. At zero loading, the collisions suffered by a Xenon molecule can be regarded as being entirely with the pore walls, since the concentration of Xenon molecules in the system is very low. Thus, the mean free path λ is a measure of the distance travelled by a Xenon molecule before colliding with a wall, and hence is also a measure of the pore dimension. SAXS data reported in previous quarters gave the average radius of gyration R_g which is also a measure of the average dimension of the pores of the material. In addition, application of the potential theory to the CO_2 (274 K) adsorption data allowed the determination of a characteristic adsorption potential E, which is inversely proportional to the width of the pore. Thus, E should correlate inversely with the mean free path λ as determined using ^{129}Xe NMR. Also, E should correlate inversely with the radius of gyration R_g from SAXS experiments. Another parameter obtained by analysis of the CO_2 (274 K) adsorption data is the exponent n in the Dubinin-Astakhov equation. We had shown in previous quarters that this is a measure of the heterogeneity of the material.

20687 (DOE/PC/91303–T10) **Semiconductor electrochemistry of coal pyrite: Technical progress report, October–December 1993.** Osseo-Asare, K.; Wei, D. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. Mar 1994. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91303. Order Number DE94013065. Source: OSTI; NTIS; GPO Dep.

The effects of the semiconductor properties of pyrite on its electrochemical behavior have been explored with the aid of energy level diagram which illustrate the relationship between the energy levels of the solid land the equilibrium potentials of the redox couples in the aqueous solution. A novel approach to the study of pyrite electrochemistry was initiated. This approach is based on pyrite microelectrodes synthesized via aqueous phase precipitation. Preliminary results show that photocurrents can be generated by illumination of the pyrite particles synthesized in our laboratory. Central to this research is the recognition that pyrite is a semiconductor material. (Photo) electrochemical experiments are conducted to unravel the mechanisms of anodic and cathodic processes such as those associated with pyrite decomposition and the reduction of oxidants such as molecular oxygen and the ferric ion.

20688 (DOE/PC/92521–T147) **Analyzing organic sulfur in coal/char: Integrated mild degradation/XANES methods: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Palmer, S.R. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Mechanical Engineering and Energy Processes); Huffman, G.P. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012574. Source: OSTI; NTIS; GPO Dep.

The cost effective removal of sulfur from coal has been very difficult to accomplish. Perhaps the single most important reason for this is the fact that the organic sulfur in coal remains very poorly characterized. The overall goal of this study is to improve our understanding of sulfur in coals/chars via the use of combined advanced non-destructive and advanced destructive methods of sulfur analysis. This study combines selective oxidation, analytical pyrolysis, and sulfur X-ray Absorption Near Edge Structure Spectroscopy (XANES) analysis. Examination of samples that were oxidized with peroxyacetic acid using the analytical pyrolysis technique showed that the level of simple thiophene structures observed in the pyrolysis products declines with increasing levels of oxidation. Sulfur XANES spectra of treated samples showed various effects depending on the treatment severity. For the less severely treated samples (demineralization and solvent extraction), the XANES spectra were similar, although not identical, to the untreated coal spectra, whereas the more severe treatments (steam at 450°C; peroxyacetic acid at 25°C) showed preferential oxidation of one or more sulfur-bearing phases in the original coal.

20689 (DOE/PC/92531–T5) **Heteronuclear probes of coal structure and reactivity: Quarterly report, January–March 1994.** Verkade, J.G.; Hall, G. Ames Lab., IA (United States). 30 Apr 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92531. Order Number DE94013480. Source: OSTI; NTIS; GPO Dep.

One of the goals of the proposal is to employ solution ^{31}P NMR spectroscopy in tandem with HPLC to speciate and quantitate phenols in coal resids. As solution ^{31}P NMR tagging agents, we are using both 1 and 2 since the ^{31}P chemical shifts provided by each are different for identical phenols. This allows a cross-check on the indentity of phenols (especially isomeric examples) as well as their

concentration. By building a library of ^{31}P chemical shifts of a wide variety of phenols derivatized with 1 and 2, speciation of phenols in coal liquids, for example, can be accomplished. Using preparative HPLC, we can separate the phenols and also derivatize them with 1 and 2 for speciation. Tables III and IV list chemical shifts for phenols derivatized with 1 and 2, respectively. In Table V we hst the total phenol contents of three Consol coal reaids using reagent 1 and a ^{31}P NMR procedure we reported earlier. We are gratified to note how well our quantitations compare with those reported in the literature using FTER spectroscopy. Because sample 3 contained paramagnetic species, speciation of phenols was precluded, owing to peak breadth and overlap. However, samples 1 and 2 produced well-resolved signals. We are now in the process of identifying the phenols responsible for these peaks.

20690 (DOE/PC/92544–7) **Vapor pressures and heats of vaporization of primary coal tars: Quarterly technical progress report, January 1, 1994–March 31, 1994.** Suuberg, E.M. Brown Univ., Providence, RI (United States). Div. of Engineering. [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92544. Order Number DE94012613. Source: OSTI; NTIS; GPO Dep.

The vapor pressure correlations that exist at present for coal tars are very crude and they are not considered reliable to even an order of magnitude when applied to tars. Sophisticated general correlative approaches are slowly being developed, based upon group contribution methods, or based upon some key functional features of the molecules. These are as yet difficult to apply to coal tars. The detailed group contribution methods, in which fairly precise structural information is needed, do not lend themselves well for application to very complex, poorly characterized coal tars. The methods based upon more global types of characterizations have not yet dealt much with the question of oxygenated functional groups. In short, only very limited correlations exist, and these are not considered reliable to even an order of magnitude when applied to tars. The present project seeks to address this important gap in the near term by direct measurement of vapor pressures of coal tar fractions, by application of well-established techniques and modifications thereof. The principal objectives of the program are to: (1) obtain data on the vapor pressures and heats of vaporization of tars from a range of ranks of coal, (2) develop correlations based on a minimum set of conveniently measurable characteristics of the tars, (3) develop equipment that would allow performing such measurements in a reliable, straightforward fashion.

20691 (DOE/PC/93223–T2) **Surface properties of photo-oxidized bituminous coals: Technical progress report, December 1993–March 1994.** Mitchell, G.; Davis, A. Pennsylvania State Univ., University Park, PA (United States). Coal and Organic Petrology Labs. Apr 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93223. Order Number DE94012604. Source: OSTI; NTIS; GPO Dep.

During the report period, channel and block samples of the Pittsburgh seam (DECS-23) were collected from Consolidation Coal Company's Bailey Mine and were subsequently processed and partly analyzed. Powdered vitrinite concentrates were prepared from the block samples in a nitrogen-filled glovebox, and small coal blocks containing ~5 mm thick vitrain bands were cut from the larger sections. Results of proximate, ultimate and petrographic analyses showed that the concentrate contained 97% (by volume, dmmf) vitrinite and about 3% (by weight) pyrite. On the basis of fluorescence intensity and alteration measurements, the coal and concentrate appeared to be extremely fresh, exhibiting no signs of oxidation or deterioration. A polished surface of one of the small coal blocks was prepared and photo-oxidized in order to evaluate reflectance-mode FTIR equipment and techniques, as well as for the measurement of contact angles. Photo-oxidation of this sample was accomplished by blue-light irradiation. In addition, arrangements are being made for the collection of two Lower Kittanning seam coal samples (marine- and freshwater-influenced) from northwestern Pennsylvania.

20692 (ECN-C–93-071) **Coal and char classification: Data compilation.** Vleeskens, J.M.; Roos, C.M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Dec 1993. 49p. Project EC JOUF-0050-C(TT). Order Number DE94774377. Source: OSTI; NTIS; Available from the library of the Netherlands Energy Research Foundation (ECN), P.O. Box 1, 1755 ZG Petten (Netherlands).

This report is a summary of experimental data obtained by the Netherlands Energy Research Foundation (ECN) in Petten, Netherlands, in the framework of the European Committee project on the title subject which was carried out in cooperation with European Center for Coal Specimens SBN, INCAR (Oviedo, Spain), KEMA (Arnhem, Netherlands) and NCRL (Newcastle on Tyne, UK). This data report is to supplement the final project report.

The aim of the project is to assess the effect of char type on combustion efficiency under conditions of temperature and turbulent flow that exist during pulverized coal combustion. Char classification methods based on morphology were evaluated in relation to the process. Samples were classified by optical microscopy and scanning electron microscopy. The majority of these results has been reported in the open literature, jointly with the partners in this project. This compilation is intended as an account of experimental data. Conclusions from these results have been reported elsewhere. 33 figs., 1 tab., 11 refs.

20693 (ECN-C–93-081) **Final stages of pulverized coal combustion.** Vleeskens, J.M.; Roos, C.M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Dec 1993. 31p. Project EC JOUF-0050-C(TT). Order Number DE94774378. Source: OSTI; NTIS; Available from the library of the Netherlands Energy Research Foundation (ECN), P.O. Box 1, 1755 ZG Petten (Netherlands).

The work on the title subject has been executed by the Netherlands Energy Research Foundation (ECN) in Petten, Netherlands, under subcontract with the European Center for Coal Specimens SBN.

The aims of the project are to develop methods for classification of pulverized fuel combusted (pfc) chars, and to link the results to combustion data from benchscale and industrial size pfc combustors. This text is a report on application of char texture identification methods to the operation of technical size pulverized coal combustors. The possibilities and limitations of optical microscopy are discussed. It is assessed to what extent coal type affects the combustion efficiency under conditions of high temperature and turbulent flow that exist in the boilers of a pfc power station. Char samples from four medium to high-inertinite coals varying in burn-off between 20% and 99.7% were taken from the KEMA 1 MW combustion test facility and classified by optical microscopy. The concentration of inertinite-type particles in char does not change significantly at intermediate stages of combustion, between 30% and 90% burn-out. When less than 10% of the original coal is left unburnt, there is a shift in char composition. Higher concentrations of large (>8μm) fusinoid and inertoid particles are found in the last stage of burn-out. In the fly ash char, the percentage unburnt from inertinite is only slightly higher than the average unburnt from the whole coal. As a spin-off from this project a few samples from the Borssele 400 MW boiler were investigated by both optical and scanning electron microscopy. Preliminary results suggest that SEM-data reflect the progress of particle burn-out, independently of coal type. 13 figs., 2 tabs., 10 refs.

0108 Waste Management

Refer also to citation(s) 20721, 20766, 21285, 21296, 21301

20694 (DOE/FE–0299P) **Clean Coal Technology Demonstration Program: Program update 1993.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Mar 1994. 262p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012389. Source: OSTI; NTIS; GPO Dep.

The Clean Coal Technology Demonstration Program (also referred to as the CCT Program) is a $6.9 billion cost-shared industry/government technology development effort. The program is to demonstrate a new generation of advanced coal-based technologies, with the most promising technologies being moved into the domestic and international marketplace. Technology has a vital role in ensuring that coal can continue to serve U.S. energy interests and enhance opportunities for economic growth and employment

while meeting the national committment to a clean and healthy global environment. These technologies are being advanced through the CCT Program. The CCT Program supports three substantive national objectives: ensuring a sustainable environment through technology; enhancing energy efficiency and reliability; providing opportunities for economic growth and employment. The technologies being demonstrated under the CCT Program reduce the emissions of sulfur oxides, nitrogen oxides, greenhouse gases, hazardous air pollutants, solid and liquid wastes, and other emissions resulting from coal use or conversion to other fuel forms. These emissions reductions are achieved with efficiencies greater than or equal to currently available technologies.

20695 (DOE/MC/10637–3663, pp. Paper 2, 42) **Waste management.** Moretti, C.J. (Univ. of North Dakota, Grand Forks, ND (United States)); Pflughoeft-Hassett, D.; Hassett, D.J.; Mayer, G.G.; Stepan, D.J. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The objective of the Waste Management project is to characterize waste materials and by-products from advanced coal utilization processes, evaluate potential uses for these materials, and identify potential adverse environmental impacts associated with their use and/or disposal. Research is also being done to develop innovative waste management techniques for conventional and advanced coal utilization processes to comply with existing and/or future environmental regulations. The activities of the Waste Management project include the following tasks: Task 1. Activated Carbon Evaluation Purpose - to evaluate the use of coal gasification char as activated carbon. Task 2. Waste Characterization Purpose - to characterize solid wastes from advanced coal utilization processes being developed at the Energy and Environmental Research Center (EERC). Task 3. Coal Utilization Waste Conditioning Study Purpose - to evaluate conditioning procedures for advanced coal utilization wastes. Task 4. Bituminous Coal Fly Ash Data Collection and Evaluation Purpose - to collect and evaluate data concerning the chemical and mineral compositions and physical properties of bituminous coal fly ash.

20696 (DOE/MC/10637–3703, pp. Paper 1, 48) **Flue gas cleanup.** Miller, S.J. (Univ. of North Dakota, Grand Forks, ND (United States)); Heidt, M.K.; Laudal, D.L.; Weber, G.F. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

From April 1983 through March 1988, the focus of the Cooperative Agreement SO_x/NO_x Control project was investigation of dry sorbent injection for SO_x control and methods of enhancingl SO_x sorbent reactivity/utilization. The primary emphasis was furnace injection of calcium-based sorbents with some experiments evaluating back-end humidification. In April 1988, the emphasis of the project was changed to advanced NO_x emissions from industrial-scale combustors. Specific activities for the period April 1988 through June 1989 focused on the bench-scale evaluation of a catalyst-coated woven fabric filter for simultaneous NO_x and particulate control. In June 1989, the project name was changed from SO_x/NO_x Control to Flue Gas Cleanup, and the scope of project activities was expanded to include tasks supporting bench-scale work in the fine-particulate control area. Work in the fine-particulate control area was included as a separate project within the Cooperative Agreement from April 1983 through March 1988 and was also funded as result of a competitive DOE award during the period May 1988 through December 1989.

20697 (DOE/MC/10637–3703, pp. Paper 2, 57) **Waste management: Semiannual technical progress report for the period January 1, 1992 - June 30, 1992.** Stepan, D.J. (Univ. of North Dakota, Grand Forks, ND (United States)); Pflughoeft-Hassett, D.F.; Strobel, T.M.; Fraley, R.H. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The Western Fly Ash Research, Development, and Data Center (WFARDDC) is a research group funded by a consortium of sponsors interested in the utilization and safe economical disposal of coal by-products. A major research effort since the initiation of the WFARDDC has been the development of a database of information on the physical, chemical, and mineralogical properties of low-rank coal by-products, primarily fly ash. A database, such as the one generated by the WFARDDC, provides a valuable source of scientific and engineering information. The format is useful in identifying trends and specific information pertinent to current and potential utilization applications as well as disposal scenarios and research projects involving coal by-products. The current version of the Western Fly Ash Database contains entries representing more than 500 samples of low-rank coal by-products. WFARDDC researchers have begun a statistical evaluation of the information in this database. Information continues to be entered into the database, and the evaluation process is continuing. The initial evaluation of the database has provided valuable information regarding low-rank coal by-products and has initiated interest in researchers, electric power utilities, coal by-products marketers, and others to extend the database to include similar information on bituminous coal by-products. Bituminous coal fly ash is of particular interest due to the high volume of this material utilized and disposed, primarily in the midwest and eastern United States. A database of information on bituminous coal fly ash has the potential to provide information valuable to the electric utility industry as it strives to meet regulatory mandates, such as the Clean Air Act, by blending coal and utilizing alternate coal combustion methods and by-products collection systems.

20698 (DOE/MC/10637–3703, pp. Paper 4, 40) **Hot-gas cleanup.** Jones, M.L. (Univ. of North Dakota, Grand Forks, ND (United States)); Haley, J.S.; Hurley, J.; Ljubicic, B.; Ramanathan, M. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The U.S. Department of Energy (DOE) is promoting the development of coal-based advanced power systems under the direction of the Morgantown Energy Technology Center (METC). This activity covers a broad range of technologies involving combustion, gasification, and the integration of combustion and gasification technologies. The objective is to maximize cycle efficiencies to provide for a stable, secure, and environmentally sound energy future. Specific combustion program areas include the development of heat engines such as direct coal-fired turbines and diesels and pressurized fluidized-bed combustion (PFBC). Gasification technology development includes mild gasification for coproducts and hydrogen and methane production for fuel cell applications. Integrated gasification combined cycle (IGCC) technology promotes high cycle efficiencies by combining coal gasification with direct product-gas firing in turbines. In all of these cases, hot-gas cleanup systems are required to achieve acceptable process performance and to meet current and future environmental emission standards.

20699 (DOE/MC/10637–3703, pp. Paper 6, 114) **Combustion inorganic transformations.** Zygarlicke, C.J. (Univ. of North Dakota, Grand Forks, ND (United States)); Katrinak, K.A.; Erickson, T.A.; Folkedahl, B.S.; Galbreath, K.C.; McCollor, D.P.; Ramanathan, M. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

Two models have been developed to predict fly ash particle size and composition from initial coal composition: (1) a stochastic model, "ATRAN1," which combines coal inorganics in a random manner and outputs a predicted fly ash particle size and composition; and (2) and expert system model, "ASHPERT," which gives a first-order estimate of fly ash size and composition, relying heavily on a large empirical database. Both models input data obtained through computer-controlled scanning electron microscopy (CCSEM), chemical fractionation, bulk elemental composition, and proximate analyses.

20700 (DOE/METC/C–94/7130) **Advanced coal technology by-products: Long-term results from landfill test cells and their implications for reuse or disposal applications.** Weinberg,

A. (Radian Corp., Austin, TX (United States)); Harness, J.L. US-DOE Morgantown Energy Technology Center, WV (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). (CONF-940632–12: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012394. Source: OSTI; NTIS; GPO Dep.

New air pollution regulations under the 1991 Clean Air Act and other legislation are motivating continued development and implementation, of cleaner, more efficient processes for converting coal to electrical power. These clean coal processes produce solid by-products which differ in important respects from conventional pulverized coal combustion ash. Clean coal by-products' contain both residual sorbent and captured SO_2 control products, as well as the mineral component of the coal. The Department of Energy/ Morgantown Energy Technology Center has contracted Radian Corporation to construct and monitor landfill test cells with a several different advanced coal combustion by-products at three locations around the US; data from these sites provide a unique picture of the long-term field behavior of clean coal combustion by-products. The field testing sites were located in western Colorado, northern Ohio, and central Illinois. Fluidized bed combustion and lime injection residues are characterized by high lime and calcium sulfate contents' contributed by reacted and unreacted sorbent materials, and produce an leachate, when wetted. Compared with conventional coal fly ash, the clean coal technology ashes have been noted for potential difficulties when wetted, including corrosivity, heat generation, cementation, and swelling on hydration. On the other hand, the high lime content and chemical reactivity of clean coal residues offer potential benefits in reuse as a cementitious material.The results of three years of data collection suggest a fairly consistent pattern of behavior for the calcium-based dry sorbent systems involved in the project, despite differences in the initial of the by-products, differences in the methods of placement, and differences in climate at the test sites.

20701 (DOE/PC/91295–T10) **A novel, integrated treatment system for coal waste waters: Quarterly report, 2 December 1993–1 March 1994.** Wang, H.Y.; Srinivasan, R. Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering. [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91295. Order Number DE94013469. Source: OSTI; NTIS; GPO Dep.

One of the specific aims of the study has been to remove and recover cationic and anionic heavy metals from aqueous solutions using modified-clay adsorbents developed in this study. To this end, hectorite-CBDA-DT (HCDT), one of the adsorbents the authors have so far prepared, has been used in a multi-step adsorption/desorption process. Briefly, the multi-step adsorption/ desorption process involves initially contacting the adsorbent with a solution of heavy metal ion (Cu(II) or Cr(VI)) at a pH which corresponds to maximal adsorption of the respective metal ion (7.4 or 8.8 for Cu(II) and 3.5–4.0 for Cr(VI)). Desorption of adsorbed metal ion is effected by adjusting the solution pH to a value at which the respective metal ion is optimally desorbed (3.0 for Cu(II) and 10.0 for Cr(VI)). Multi-step involves cycling the same adsorbent through the two pH values repeatedly. Results indicate that, for Cu(II) ions, HCDT can be used at least 5 times and the loss of adsorption (removal) and desorption (recovery) efficiency is only 15% of the initial value. Further, the overall mass balance of the Cu(II) system is 95%. However, with Cr(VI), the same adsorbent loses more than 40% of its potency after 4 cycles. Further, the overall mass balance averages to only 75% in the case of Cr(VI) removal and recovery. It is believed that differences in the operational performance in the two cases can be attributed to different adsorption mechanisms: surface chelate formation (dependent only on local pH) and counter ion binding (responsive to local pH and ionic strength) respectively in the case of Cu(II) and Cr(VI).

20702 (DOE/PC/92521–T135) **Plasma-assisted cleanup of flue gas: Technical report, 1 December 1993–28 February 1994.** Dhali, S.K. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Electrical Engineering). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012562. Source: OSTI; NTIS; GPO Dep.

The authors have conclusively demonstrated that plasma chemistry alone is sufficient to convert SO_2 to H_2SO_4, the plasma being produced by a dielectric-barrier discharge. They get nearly 80% removal of SO_2 in a flue gas containing 775 ppm (parts per million) of SO_2 and 99% for SO_2 in concentrations of 300 ppm. A significant achievement during this period is the progress the authors have made with the wetting of the glass by the acid. They are using a simple and cheap method of coating the glass with Teflon (PTFE 30) to provide a hydrophobic surface. These films show chemical inertness to nearly all chemical and solvents and have low friction and antistick surfaces. The following important conclusions can be drawn from the results: (1) The percentage removal does not show saturation with the applied voltage. (2) The removal efficiency at an inlet temperature of 300 C is almost similar to 25 C at high voltages. (3) With longer electrodes the efficiency of removal increases. These results suggest that removal efficiency can be improved further by increasing the voltage and electrode length. The authors are yet to exploit the full range of parameters available. Therefore, it is likely that they will get much improved performance from the system.

20703 (DOE/PC/92521–T139) **Plant response to FBC waste-coal slurry solid mixtures: [Quarterly] technical report, December 1–February 28, 1994.** Darmody, R.G. (Illinois Univ., Urbana, IL (United States)); Dunker, R.E.; Dreher, G.B.; Roy, W.R.; Steel, J.D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012566. Source: OSTI; NTIS; GPO Dep.

The goal of this project is to test the feasibility of stabilizing coal slurry solids (CSS) wastes by directly seeding plants into the waste. This is not done conventionally because the waste can generate toxic amounts of sulfuric acid. Our approach is to neutralize the potential acidity by mixing fluidized bed combustion (FBC) waste into the slurry. If successful this approach would both help dispose of FBC wastes while providing a more economical slurry stabilization technique. The project involves growing forage plants in CSS-FBC mixtures in the greenhouse. This is the second quarter of the project. We have designed the experiment, secured greenhouse space, purchased the seeds, collected, dried, and are analyzing the FBC and CSS samples. The samples represent a typical range of properties. We retrieved two FBC and two CSS samples. One CSS sample had a relatively high $CaCO_3$ content relative to the pyrite content and will require no FBC to neutralize the potential acidity. The other CSS sample will require from 4.2 to 2.7% FBC material to neutralize its potential acidity.

20704 (DOE/PC/92521–T140) **Microbial stabilization of sulfur-laden sorbents: Technical report, 1 December 1993–28 February 1994.** Miller, K.W. (Illinois State Univ., Normal, IL (United States)). Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012567. Source: OSTI; NTIS; GPO Dep.

Clean coal technologies that involve limestone for sulfur capture generate lime/limestone products laden with sulfur at various oxidation states. If sulfur is completely stabilized as sulfate, the spend sorbent is ready for commercial utilization as gypsum. However, the presence of reduced sulfur species required additional processing. Thermal oxidation of reduced sulfur can result in undesirable release of SO_2. Microbial oxidation might provide an inexpensive and effective alternative. Sorbents laden with reduced forms of sulfur such as sulfide, sulfite, or various polythionate species serve as growth substrates for sulfur-oxidizing bacteria, which have the potential to convert all sulfur to sulfate. This quarter, efforts focused on treating the aqueous phase of a waste sorbent obtained from an inhibited wet scrubbing process. Although two named strains, Thiobacillus neapolitanus ATCC 23639 and ATCC 23641, failed; the isolate TQ1 rapidly oxidized thiosalts, producing sulfate. The Virtis Fermentor arrived, so that experiments with TQ1 have been scaled up to 1.5 liters with temperature, aeration, and pH control.

20705 (OCDO–94012357) **Pilot-scale limestone emission control (LEC) process: A development project. Volume 1:**

Main report and appendices A, B, C, and D: Final report. Ohio Univ., Athens, OH (United States). Mar 1994. 249p. Sponsored by Ohio State Government, Columbus, OH (United States). Grant CDO/D-88-49. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

ETS, Inc., a pollution consulting firm with headquarters in Roanoke, Virginia, has developed a dry, limestone-based flue gas desulfurization (FGD) system. This SO_2 removal system, called Limestone Emission Control (LEC), can be designed for installation on either new or existing coal-fired boilers. In the LEC process, the SO_2 in the flue gas reacts with wetted granular limestone that is contained in a moving bed. A surface layer of principally calcium sulfate ($CaSO_4$) is formed on the limestone. Periodic removal of this surface layer by mechanical agitation allows high utilization of the limestone granules. The primary goal of the current study is the demonstration of the techno/economic capability of the LEC system as a post-combustion FGD process capable of use in both existing and future coal-fired boiler facilities burning high-sulfur coal. A nominal 5,000 acfm LEC pilot plant has been designed, fabricated and installed on the slipstream of a 70,000 pph stoker boiler providing steam to Ohio University's Athens, Ohio campus. The pilot plant was normally operated on the slipstream of the Ohio Univ. boiler plant flue gas, but also had the capability of operating at higher inlet SO_2 concentrations (typically equivalent to 3-1/2% sulfur coal) than those normally available from the flue gas slipstream. This was accomplished by injecting SO_2 gas into the slipstream inlet. The pilot plant was instrumented to provide around-the-clock operation and was fully outfitted with temperature, SO_2, gas flow and pressure drop monitors.

20706 (OCDO–94012362) **Sorbent utilization studies using a mini-pilot spray dryer: Final report, 1 September 1992–31 August 1993.** Keener, T.C.; Khang, S.J.; Wang, J.; Sanders, J.F. Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering. 30 Sep 1993. 50p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The main body of the report consists of four parts: 1. additives to change process chemistry for SO_2 absorption by $Ca(OH)_2$ slurry; 2. recycle tests and hydration of fly ash with $Ca(OH)_2$ to increase reactivity; 3. limestone as an alternative sorbent and additive effects; 4. physical and chemical model developments for some of the additive effects and spray dryer mathematical model application. As the concentration of SO_2 in the flue gases increases, the SO_2 removal efficiency will go down. Additives such as delinquent salts (NaOH, NaCl, and $NaHCO_3$) have been shown to improve SO_2 uptake, and these additive tests have indicated that SO_2 uptake may be increased by as much as 60% over baseline conditions. Other additives such as H_2O_2, sugar, and some organic acids which can change the chemical reaction processes are suggested and tested, and some promising results have been obtained. Recycle has been shown to increase sorbent utilization by allowing partially reacted sorbent to react further with the SO_2 in the flue gases. Two types of Ohio coal fly ashes have been extensively studied, and improvement of utilization in spray dryer flue gas desulfurization has been demonstrated. Limestone represents an area where significant cost savings can be realized. The spray dryer tests were designed to provide some results for understanding the magnitude of the limestone performance in the spray dryer system and the additive effects. The additive effects on increasing SO_2 absorption by $Ca(OH)_2$ slurry were investigated, and the chemical and physical properties of these tested additives were studied. Some models have been formed to explain the additive phenomena.

0109 Environmental Aspects

Refer also to citation(s) 20693, 20702, 22488

20707 (DOE/MC/10637–3703, pp. Paper 12, 17) **Nitrous oxide emissions.** Mann, M.D. (Univ. of North Dakota, Grand Forks, ND (United States)); Collings, M.E.; Young, B.C. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

Due to growing scientific and public concern relating elevated CO_2 concentration to changes in the global climate, other trace gases including CH_4, chlorofluorocarbons (CFCs), and nitrous oxide (N_2O) have become suspect as contributors to the greenhouse effect and ozone depletion. N_2O is reportedly increasing in atmospheric concentrations at an estimated rate of 0.7 ppb per year (1) and was measured (1988) as present in the atmosphere at a concentration of 307 ppb (2). Although the atmospheric concentrations of N_2O are low (1100 times less than CO_2), the relative strength of N_2O as an infrared absorber is reportedly 200 times more than CO_2 (2). In addition, N_2O, a stable compound, is transported to the stratosphere where it is photochemically oxidized to nitric oxide (NO), the major contributor to catalytic ozone depletion. The association and/or contribution of N_2O to the greenhouse effect and ozone reduction has led to considerable interest in determining the natural and man-made pathways to its formation and destruction.

0110 Reserves, Geology, and Exploration

20708 (DOE/MC/10637–3663, pp. Paper 9, 37) **Coal sciences.** Hartman, J.H. (Univ. of North Dakota Energy and Environmental Research Center, Grand Forks, ND (United States)). North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The general "Coal Science" objective of the North Dakota Mining and Mineral Research Institute (MMRRI) is directed towards a fuller utilization of energy and energy-related data, currently available as published and unpublished documents, to better evaluate resource potential through a thorough knowledge and understanding of the geologic context of the resource. This objective is to be implemented through computer-based data management systems involving specific field examples. The focus of the first phase of the project is to establish the computerized basis for reevaluating, or evaluating locally for the first time, North Dakota's lignite resource in a stratigraphic and paleontologic context. Specific fundamental goals include the construction of flexible, relatable data base designs and the testing of these designs through practical examples.

20709 (DOE/MC/10637–3703, pp. Paper 9, 21) **Coal science earth resource evaluation and management.** Hartman, J.H. (Univ. of North Dakota, Grand Forks, ND (United States)). North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The general "Coal Science" objective of the Energy and Environmental Research Center (EERC) Mining and Mineral Resources Research Institute (MMRRI) is directed towards a fuller utilization of energy and associated energy-related data, currently available as published and unpublished documents, to better evaluate resource potential through a thorough knowledge and understanding of the geologic context of the resource. This objective is to be implemented through computer-based data management systems involving specific field examples. The focus of Year Three of the project is to further develop a computerized basis for evaluating North Dakota's lignite resource in a stratigraphic and paleontologic context. Specific goals include the construction of enhanced, but flexible, relatable database designs in stratigraphy, paleontology, and geochemistry and the testing of these designs through practical examples.

0120 Mining

Refer also to citation(s) 20737

20710 (KTM/E-B–157) **OPTIMITURVE - Peat production based on solar energy: Final report on the energy research programme 1988-1992.** Leinonen, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab.); Erkkilae, A. Ministry of Trade and Industry, Helsinki

(Finland). Energy Dept. 1994. 140p. Project KTM-275/881/87. Order Number DE94771071. Source: OSTI; NTIS.

Published in Finnish as the report KTM/E-B–156.

The aim of the Optimiturve research programme was to develop a peat production method based on solar energy, the efficiency and the profitability of which would be twice as high as those of previous methods. Due to the efficiency, which means a higher peat yield per hectare, the circulation of the capital invested in peat production increases and further boosts the competitiveness of peat. It was calculated that if the target of the research programme can be fulfilled, peat production costs could be reduced by 20 %. The total budget of the programme amounted to 44,3 million FIM. Basic knowledge for ditching of the bog, drying of milled peat, milling, pneumatic harvesting, drying of sod peat, maceration and excavation have been developed in the course of the Optimiturve research programme. Additionally, peat production planning and control have been studied and developed. A new milled peat production method, the so called TEHOTURVE method, and a new combined production method for milled and sod peat, the MULTI method, have been developed on this basis. The guiding principle of the TEHOTURVE method is that the average grain size of the milled layer to be dried increased from 5 mm to 15 mm and the collection coefficient of the ridger increased from 50 % to 80 %. Ridging of several harvests on the same ridge, efficient loading and driving are also typical of the method. The MULTI method is a combined production method for milled and sod peat. The method is based on sod peat production using the ridge drying method (TUPLA), in which two harvests are produced simultaneously. The first harvest is dried on the field and the other on the ridge.

20711 (NEI-FI–231) **Removal of stumps from the peat production fields.** Niskanen, K.; Luoma-aho, H. Vapo Oy, Jyvaeskylae (Finland). 1991. 16p. (In Finnish). Order Number DE94771058. Source: OSTI; NTIS.

Project KTM-116/881/90.

The aim of the project was to develop machines and methods to remove the stumps from the peat production fields effectively and economically. The existing equipment needs tracks in the pulling tractor because of the weight. During the project, a new type of removal and handling machines were designed, constructed and tested. They can be operated with a normal wheel tractor.

20712 (SAND–94-1193C) **Blasting detonators incorporating semiconductor bridge technology.** Bickes, R.W. Jr. Sandia National Labs., Albuquerque, NM (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–13: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011431. Source: OSTI; NTIS; GPO Dep.

Includes vugraphs.

The enormity of the coal mine and extraction industries in Russia and the obvious need in both Russia and the US for cost savings and enhanced safety in those industries suggests that joint studies and research would be of mutual benefit. The author suggests that mine sites and well platforms in Russia offer an excellent opportunity for the testing of Sandia's precise time-delay semiconductor bridge detonators, with the potential for commercialization of the detonators for Russian and other world markets by both US and Russian companies. Sandia's semiconductor bridge is generating interest among the blasting, mining and perforation industries. The semiconductor bridge is approximately 100 microns long, 380 microns wide and 2 microns thick. The input energy required for semiconductor bridge ignition is one-tenth the energy required for conventional bridgewire devices. Because semiconductor bridge processing is compatible with other microcircuit processing, timing and logic circuits can be incorporated onto the chip with the bridge. These circuits can provide for the precise timing demanded for cast effecting blasting. Indeed tests by Martin Marietta and computer studies by Sandia have shown that such precise timing provides for more uniform rock fragmentation, less fly rock, reduce4d ground shock, fewer ground contaminants and less dust. Cost studies have revealed that the use of precisely timed semiconductor bridges can provide a savings of $200,000 per site per year. In addition to Russia's vast mineral resources, the Russian Mining Institute outside Moscow has had significant programs in rock fragmentation for many years. He anticipated that collaborative studies by the Institute and Sandia's modellers would be a valuable resource for field studies.

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Refer also to citation(s) 20628, 20638, 20663, 20682, 20691, 20692, 21285, 21287, 21292, 21767, 21769, 21770, 21771, 21844, 22046, 22230

20713 (CONF-940838–6) **Evolution of porosity and thermal conductivity during char oxidation.** Weiss, Y. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Mechanical Engineering); Benari, Y.; Kantorovich, I.I.; Bar-Ziv, E.; Krammer, G.; Modestino, A.; Sarofim, A.F. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering; Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Mechanical Engineering. [1994]. 19p. Sponsored by USDOE, Washington, DC (United States);Ministry of Science and Technology, Jerusalem (Israel);United States-Israel Binational Science Foundation, Jerusalem (Israel);Fonds zur Foerderung der Wissenschaftlichen Forschung, Wien (Austria). DOE Contract FG22-91PC91294. Grant 88-157. From 25. combustion symposium; Irvine, CA (United States); 1 Aug 1994. Order Number DE94010319. Source: OSTI; NTIS; GPO Dep.

Measurements of the natural convection drag and the photophoretic force have been conducted for Spherocarb char particles as a function of carbon conversion. These forces were obtained by measuring the balancing voltage with and without laser heating during the reaction of single particles in an electrodynamic balance. The photophoretic force was determined by subtraction of the calculated natural convection force, after an initial transient corresponding to about five percent carbon conversion during which the natural convection force was dominant. The particle conductivity inferred from the photophoretic force was found to increase by more than one order of magnitude as the reaction progressed, qualitatively in agreement with models of the dependence of conductivity on porosity. Confirmation of the temperature gradient across the particle was provided by the development of asphericity in the particles when heated from below but not when heated uniformly. The simultaneous measurements of the mass, diameter, and particles conductivity as a function of carbon conversion provides a critical test of pore evolution models since the reaction rate is dependent on the accessibility of the internal surface area to the reactant gas through the open pore structure and the thermal conductivity is dependent on the connectivity of the solid structure. Induction periods were observed before the reaction rate accelerated and the particle conductivity declined, confirming the influence of pore structure on both. Particles could be reacted to a high conversion of greater than 95 percent without any evidence of fragmentation providing further insight on the connectivity of the solid surfaces.

20714 (DOE/MC/10637–3663, pp. Paper 4, 25) **Turbine combustion phenomena.** Swanson, M.L. (Univ. of North Dakota, Grand Forks, ND (United States)); Mann, M.D.; Moe, T.A. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly*. 697p. Order Number DE94004080. Source: OSTI; NTIS.

Under DOE sponsorship, coal/water slurry fuels have been investigated as fuels for gas turbine engines for several years, but the major technical problems still inhibiting commercialization are deposits on the pressure and suction sides of the turbine blades, reducing the gas flow area and the turbine efficiency; acceptable coal burnout, given the short residence time inherent with gas turbine engines; corrosion of turbine blades by condensed alkali sulfates; erosion of turbine blades and other components by ash particles entrained in the products of combustion; and control of NO_x, SO_2, and particulate emissions. The release of certain mineral matter species found in both raw and beneficiated coals can lead to ash deposition on surfaces, regardless of the ash content of the fuel. This deposition can lead to corrosion and metal loss of critical turbine components and, ultimately, to derating, unavailability, or catastrophic failure of the power generation system. Alkali

metals and sulfur, existing as impurities in coal, have been identified as key components in the initiation of deposition and the onset of corrosion.

20715 (DOE/MC/10637–3663, pp. Paper 10, 35) **Fluidized-bed combustion of low-rank coals.** Mann, M.D. (Univ. of North Dakota, Grand Forks, ND (United States)); Hajicek, D.R.; Henderson, A.K.; Moe, T.A. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

The main driving forces behind the use of fluidized-bed combustion have primarily been environmental concerns, fuel flexibility, and compatibility with low-cost fuels. Both bubbling and circulating designs have been developed for operation at atmospheric pressure, and many industrial-scale units of both types are currently in operation. A limited number of larger utility boilers have recently been commissioned. In addition, pressurized fluidized-bed combustion (PFBC) is making its entrance on the utility scale with the PFBC being installed at the Tidd Station.

20716 (DOE/MC/10637–3663, pp. Paper 12, 24) **Combustion characterization of low-rank coal fuels.** Mann, M.D. (Northwest Research, Inc., Grand Forks, ND (United States)); Gunderson, J.R.; Selle, J.S. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

Coal research by the Pittsburgh Energy Technology Center (PETC) of the U.S. Department of Energy (DOE) is directed toward both increasing coal usage in existing markets and introducing new, premium-quality coal-based fuels to markets currently dependent on oil or natural gas. Accordingly, the work concentrates on coal cleaning, fuel formulation/handling, combustion, and flue gas cleanup. All of these activities are necessary technologies in the direct use of coal. The progress achieved over the past several years through PETC and related federal/private sector research activities has considerably strengthened these technologies, consequently enhancing the possibility of meeting DOE's coal research goals. The industrial and utility sectors are major consumers of oil and gas. Many of these oil and gas systems could be converted to coal-fired systems, resulting in a significant reduction in the oil and gas needs of this country. As an example, oil- and gas-generating systems in the utility sector have a nameplate generating capacity of 156 gigawatts (GW). Based on remaining years of service, 91.6 GW have the potential for conversion to coal. This represents 4.8 quads of energy per year. There are similar opportunities to reduce the U.S. dependency on oil and gas in the industrial sector. A number of critical factors need to be examined to determine the success of switching from oil or gas to coal. Significant differences exist in burner designs, furnace plan areas, heat release rates, tube spacing in convective passes and number/location of soot and wall blowers. Combustion characterization of replacement fuels is needed to assess the impact of the new fuel's properties on the existing design. This characterization should help assess any equipment modifications or derating necessary as a result of switching fuels.

20717 (DOE/MC/10637–3663, pp. Paper 13, 20) **Diesel utilization of low-rank coals.** Swanson, M.L. (Univ. of North Dakota, Grand Forks, ND (United States)); Mann, M.D.; Collings, M.E. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

Lignite chars have a higher reactivity than chars of higher-ranked coals. In tests where coal/water slurries were investigated as potential heat engine fuels, the particle burning rate of lignite was four to five times higher than that of bituminous coals. A lignite slurry will therefore offer improved engine performance and may be used in higher rpm diesel application, if ash concentrations are reduced to limit engine wear and particulate emissions. The utilization of coal slurry fuels in medium-speed diesel engines offers the opportunity to replace premium petroleum-derived distillate fuels with more economical and abundant coal. Recent advances in coal technologies, such as the ability to prepare satisfactory coal/water slurry fuels and the efforts to reduce the mineral content of the parent coals in coal beneficiation processes, suggest that coal-derived fuels with low mineral contents soon may be technically feasible and utilized in a cost-effective manner in diesel engines. Until very recently, low-rank coals were not considered as parent coals for coal/water slurry fuels because of their high intrinsic moisture levels. However, with the advent of UNDEERC's hydrothermal drying process, micronized lignite slurries have been produced with solids loading up to 50 weight percent and heating values of 6000 Btu/lb of slurry. Subbituminous coals also respond very well to hydrothermal treatment and produce high-quality slurries. New coal utilization technologies designed to produce gaseous, liquid, and carbonaceous products are currently under development. These processes produce quantities of minimally processed tars and coal-derived liquids which must be utilized in some manner. These "mild gasification" liquids might provide a reasonable replacement for petroleum-derived diesel fuel.

20718 (DOE/MC/10637–3663, pp. Paper 14, 15) **Production & characterization of CWF for heat engine applications.** Potas, T.A. (Univ. of North Dakota, Grand Forks, ND (United States)); Musich, M.A.; Anderson, C.M.; Swanson, M.L. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Nov 1990. In *Low-rank coal research annual report, July 1, 1989–June 30, 1990 including quarterly.* 697p. Order Number DE94004080. Source: OSTI; NTIS.

This report describes progress towards goals and objectives related to those listed in section 1.0. Efforts have concentrated on improving the capabilities to support heat engine research by producing clean CWF from low-rank coals, and reducing the costs of the fuels produced. Hot-water drying, when integrated with wet coal cleaning techniques such as dense-media cone separation and dilute acid leaching, has produced drum quantities of CWF from LRCs with less than 2.0 wt% ash on a dry basis at solids contents up to 55 wt% and at micronized particle size (100% < 45 microns, 12 microns average). These fuels have shown excellent combustion characteristics in the GM-Allison Gas Turbine, General Electric Research and Development diesel engine, and the EERC Turbine Simulator programs, achieving higher average carbon burn-outs than bituminous fuels that have a much smaller mean particle size. The efficient operation of advanced heat engine combustion systems depends on the high carbon burn-out of CWF. Atomization quality of CWF is an important parameter related to a high carbon burn-out in these systems. It is well known that the apparent viscosity of CWFs at a high-shear rate has a dominant effect on the size distribution of atomized fuel droplets. Further background information has been previously given. The High-Shear Rheology Program will attempt to determine if CWFs, that are pseudoplastic at low-shear rates, remain pseudoplastic at high-shear rates, and if CWFs, that are dilatant at low-shear, remain dilatant at high shear.

20719 (DOE/MC/10637–3703, pp. Paper 5, 46) **Turbine combustion phenomena.** Swanson, M.L. (Univ. of North Dakota, Grand Forks, ND (United States)); Mann, M.D.; Tibbetts, J.E. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

Under DOE sponsorship coal-water slurry fuels have been investigated as fuels for gas turbine engines for several years, but the major technical problems still inhibiting commercialization are deposits on the pressure and suction sides of the turbine blades which reduce the gas flow area and turbine efficiency; acceptable coal burnout, given the short residence time inherent with gas turbine engines; corrosion of turbine blades by condensed alkali sulfates; erosion of turbine blades and other components by ash particles entrained in the products of combustion; and control of NO_x, SO_2, and particulate emissions. The release of certain mineral matter species found in both raw and beneficiated coals can lead to ash deposition on surfaces, regardless of the ash content of the fuel. This deposition can lead to corrosion on and metal loss of critical turbine components and, ultimately, to derating, unavailability, or catastrophic failure of the power generation system.

Alkali metals and sulfur, existing as impurities in coal, have been identified as key components in the initiation of deposition and the onset of corrosion.

20720 (DOE/MC/10637–3703, pp. Paper 10, 14) **Atmospheric fluidized-bed combustion.** Mann, M.D. (Univ. of North Dakota, Grand Forks, ND (United States)); Moe, T.A. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The main driving forces behind the use of fluidized-bed combustion have primarily been environmental concerns, fuel flexibility, and compatibility with low-cost fuels. Both bubbling and circulating designs have been developed for operation at atmospheric pressure, and many industrial-scale units of both types are currently in operation. A limited number of larger utility boilers have recently been commissioned. In addition, pressurized fluidized-bed combustion (PFBC) is making its entrance on the utility scale with the PFBC which recently began operation at the Tidd Station.

20721 (DOE/MC/10637–3703, pp. Paper 13, 13) **Pressurized fluidized-bed combustion.** Mann, M.D. (Univ. of North Dakota, Grand Forks, ND (United States)); Rindt, J.R.; Hetland, M.D.; Hajicek, D. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

Pressurized fluidized-bed combustion (PFBC) has several advantages that make it attractive as a technology of the future, including: (1) Increased efficiency and reduced capital and generating costs compared to pulverized coal-fired (pc-fired) boilers equipped with flue gas desulfurization (FGD). (2) Modular units without the usual economy-of-scale penalty. (3) Reduced combustor size, permitting shop fabrication and field erection, thereby greatly shortening construction lead time. (4) High-sulfur fuels burned in the presence of sorbent in the fluidized-bed combustor (FBC) eliminating the need for FGD. (5) Reduced combustion temperature (1400°-1700°F versus 3000°F for a pc-fired boiler), which results in significant reduction of NO_x emissions. (6) Increased heat-transfer rate to the working fluid. (7) Increased fuel versatility. (8) Easily handled by-product material consisting of clinker-free, granular, smooth-flowing ash which may be easily disposed of for landfill uses or potentially sold for industrial or agricultural application. Major technical uncertainties indentified by the industry as critical areas for PFBC commercialization are: (a) Hot-gas cleanup for gas turbine protection, with particular reference to coal alkalies. (b) Materials survivability for heat exchanger, gas turbine, and solids-handling equipment. (c) Solids-handling improvement in feeding, distribution, and bed removal. (d) Combustor configuration, including the heat-transfer bundles, distributor plate, fuels utilization, and operational parameters.

20722 (DOE/MC/22118–3795) **Field study of disposed wastes from advanced coal processes: Quarterly technical progress report, January to April 1994.** Radian Corp., Austin, TX (United States). [1994]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC22118. Order Number DE94013382. Source: OSTI; NTIS; GPO Dep.

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal solid processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Energy & Environmental Research Center (EERC) to design, construct, and monitor a limited number of field disposal tests with advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal of these wastes. Information on field disposal behavior is needed (a) as input to predictive models being developed, (b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and (c) as evidence of the behavior of these wastes in the natural environment.This study is organized into four major Tasks. Task 1 and 2 were devoted to planning the Task 3 field study. Task 4 uses the results of the field testing to produce an Engineering Design Manual for the utilities and industrial users who manage wastes from advanced coal combustion technologies.

20723 (DOE/MC/24132–3745) **Tidd PFBC Demonstration Project: Quarterly report, January–March 1994.** American Electric Power Service Corp., Columbus, OH (United States). Apr 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24132. Order Number DE94004119. Source: OSTI; NTIS; GPO Dep.

This is the 28th Technical Progress Report submitted to the Department of Energy in connection with the Cooperative Agreement between the DOE and the Ohio Power Company for the Tidd PFBC Demonstration Plant. This report covers the period of January 1, 1994 to March 31, 1994. Major activities during this period include: (1) The unit operated for 850 hours on coal, bringing the grand total for coal fire through the end of the quarter to 6318 hours. (2) The unit availability for the first quarter was 40.1%. (3) There were twelve gas turbine starts, eight bed preheater starts, and six operating periods on coal. (4) During this quarter, total gross generation was 40,721 MWH, the peak unit output for one hour was 62 MWH, and the coal consumption was 19,370 tons. (5) Three performance tests were conducted during this quarter; and (6) the plant was able to remain in service during the sub-zero weather in January, providing power to the critically short grid.

20724 (DOE/MC/25140–94/C0342) **PFBC perspectives at the Power Systems Development Facility.** Moore, D.L. (Southern Co. Services, Inc., Birmingham, AL (United States)); Vimalchand, P.; Haq, Z.U.; McClung, J.D.; Quandt, M.T. Southern Co. Services, Inc., Birmingham, AL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC25140. (CONF-9405124–4: Electric Power Research Institute (EPRI) fluidized-bed combustion for power generation conference, Atlanta, GA (United States), 17-19 May 1994). Order Number DE94013216. Source: OSTI; NTIS; GPO Dep.

The use of coal for power generation has come under increasing environmental scrutiny over the past five years. Advances in coal-based power generation technology will develop systems that have high efficiency, environmental superiority and lower cost of electricity compared to current coal-based technology. Advanced pressurized-fluidized-bed combustion (APFBC) is one 'of the promising emerging power generation technologies striving to achieve these goals. One method of improving the efficiency and lowering the capital cost further for advanced power plants utilizing coal is by employing hot gas cleanup. Although hot gas cleanup has the potential for improving the viability of coal-based power generation, the removal of hot particulates from the gas stream has proven to be a challenging task. The demonstration of APFBC technology and the particulate control devices (PCDs) under realistic conditions for advanced power generation remain important areas for development. The Power Systems Development Facility (PSDF) is being designed to be a flexible facility that will address the development of the PCDs and an advanced second-generation PFBC technology. With the progress made in the last decade, the basic concepts of PFBC technology can be achieved through a number of different flowsheets and reactor configurations. The choices made in developing the flowsheets and the choices made in designing the equipment in order to improve the reliability of operation may well dictate, along with the actual data from operation, the process efficiencies and the capital costs that can be achieved.

20725 (DOE/MC/25177–3747) **Co-firing a pressurized fluidized-bed combustion system with coal and refuse derived fuels and/or sludges: Task 16.** DeLallo, M.; Zaharchuk, R. Gilbert/Commonwealth, Inc., Reading, PA (United States). Jan 1994. 183p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC25177. Order Number DE94004121. Source: OSTI; NTIS; GPO Dep.

The co-firing of waste materials with coal in utility scale power plants has emerged as an effective approach to produce energy and manage municipal waste. Leading this approach, the atmospheric fluidized-bed combustor (AFBC) has demonstrated its commercial acceptance in the utility market as a reliable source of power burning a variety of waste and alternative fuels. The fluidized bed, with its stability of combustion, reduces the amount of

thermochemical transients and provides for easier process control. The application of pressurized fluidized-bed combustor (PFBC) technology, although relatively new, can provide significant enhancements to the efficient production of electricity while maintaining the waste management benefits of AFBC. A study was undertaken to investigate the technical and economic feasibility of co-firing a PFBC with coal and municipal and industrial wastes. Focus was placed on the production of electricity and the efficient disposal of wastes for application in central power station and distributed locations. Wastes considered for co-firing include municipal solid waste (MSW), tire-derived fuel (TDF), sewage sludge, and industrial de-inking sludge. Issues concerning waste material preparation and feed, PFBC operation, plant emissions, and regulations are addressed. This paper describes the results of this investigation, presents conclusions on the key issues, and provides recommendations for further evaluation.

20726 (DOE/MC/27229–3786) **Pulsed atmospheric fluidized bed combustion: Technical progress report, January–March 1994.** Thermochem, Inc., Columbia, MD (United States). 29 Apr 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC27229. Order Number DE94013383. Source: OSTI; NTIS; GPO Dep.

Industra has completed design of the structure which surrounds the fluidized bed. Details regarding their efforts are discussed below. Duke/Fluor Daniel has begun overall design review and will provide comments and recommendations early in the second quarter. Foundation and control room design are complete. Drawings have been submitted to Clemson University and bids have been requested from vendors. Structural design is complete and drawings have been submitted for bids. Industra has reviewed design of the bin structures and has provided recommendations for minor additions to them. Revisions have been made to the structure and are described.

20727 (DOE/PC/89659–T16-App.-Bk.2) **Demonstration of coal reburning for cyclone boiler NO_x control: Appendix: Book 2, Final report.** Babcock and Wilcox Co., Alliance, OH (United States). Contract Research Div. Feb 1994. 711p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89659. Order Number DE94013054. Source: OSTI; NTIS; GPO Dep.

This volume, containing no text, consists of numerical monitoring data taken over the duration of the test.

20728 (DOE/PC/91162–T9) **Development & testing of industrial scale, coal fired combustion system, phase 3: Eighth quarterly technical progress report, 1 October, 1993–31 December, 1993.** Zauderer, B. Coal Tech Corp., Merion Station, PA (United States). 31 Jan 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91162. Order Number DE94013058. Source: OSTI; NTIS; GPO Dep.

The primary objective of the present Phase 3 effort is to perform the final testing at a 20 MMBtu/hr commercial scale of an air cooled, slagging coal combustor for application to industrial steam boilers and power plants. The focus of the test effort will be on combustor durability, automatic control of the combustor's operation, and optimum environmental control of emissions inside the combustor. In connection with the latter, the goal is to achieve 0.4 lb/MMBtu of SO_2 emissions, 0.2 lb/MMBtu of NO_x emissions, and 0.02 lb particulates/MMBtu. Meeting the particulate goal will require the use of a baghouse or electrostatic precipitator to augment the nominal slag retention in the combustor. The NO_x emission goal will require a modest improvement over maximum reduction achieved to date in the combustor to a level of 0.26 lb/MMBtu. To reach the SO_2 emissions goal may require a combination of sorbent injection inside the combustor and sorbent injection inside the boiler, especially in high (>3.5%) sulfur coals. Prior to the initiation of the project, SO_2 levels as low as 0.6 lb/MMBtu, equal to 81% reduction in 2% sulfur coals, were measured with boiler injection of calcium hydrate. The final objective is to define suitable commercial power or steam generating systems to which the use of the air cooled combustor offers significant technical and economic benefits. In implementing this objective both simple steam generation and combined gas turbine-steam generation systems will be considered.

20729 (DOE/PC/92152–T9) **The physics of coal liquid slurry atomization: Annual topical report, 14 March 1993–14 March 1994.** Chigier, N. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering. [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92152. Order Number DE94013482. Source: OSTI; NTIS; GPO Dep.

The stability of turbulent columns of liquid injected into a quiescent environment has been studied. Turbulence decay along Newtonian jets was investigated along with the effects of turbulence on the resulting droplet size distributions after breakup. Disintegration of liquid jets injected into a high-velocity gas stream has also been studied. Newtonian and non-Newtonian liquids were studied with particular emphasis on the non-Newtonian rheological characteristics. Determination was made of the extent that the addition of high molecular weight polymer to liquids changes the breakup process. Shear thinning, extension thinning and extension thickening fluids were investigated. The non-Newtonian viscosities were measured over five decades of shear rates for 12 solutions of polymeric materials. By using the die-swell technique, the first normal stress difference was determined for all solutions. By using the contraction flow technique, the extensional viscosity levels were determined for the most viscous solutions. The near field produced by a co-axial airblast atomizer was investigated using the phase Doppler particle analyzer. The classical wave mechanism and empirical models reported for air-blast atomization of low viscosity liquid were shown to be applicable to air-blast atomization of viscous non-Newtonian liquids. The theoretical basis of several models which give the best fit to the experimental data for air-blast atomization of non-Newtonian liquids was addressed. Conclusions to date are discussed for the following areas: Turbulence characteristics in liquid jets; The effect of turbulence on the stability of liquid columns; The rheology of mobile polymeric solutions; and Air blast atomization of non-Newtonian liquids.

20730 (DOE/PC/92152–T10) **The physics of non-Newtonian liquid slurry atomization: Part 2: Twin-fluid atomization of non-Newtonian liquids – First quarterly technical report, 1 January–31 March 1994.** Mansour, A.; Chigier, N. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering. [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92152. Order Number DE94013483. Source: OSTI; NTIS; GPO Dep.

The changes in the physical processes of atomization as a result of adding a high molecular weight polymer in low concentrations to liquid have been studied. Both Newtonian and non-Newtonian liquids were investigated with particular emphasis on the non-Newtonian rheological characteristics. It was found that viscoelastic liquids are much more difficult to atomize than viscoinelastic liquids. Viscoinelastic liquids showed a breakup behavior similar to that of water sprays. Viscoelastic materials showed remarkably different breakup patterns. The ligaments were seen to undergo a very large stretching motion before they breakup, resulting in long threads of liquid attached to droplets. The normal stresses developed in viscoelastic materials are much higher than their associated shear stresses. Consequently, the development of the large normal stresses appears to be the most important rheological mechanism that inhibits breakup. The non-Newtonian liquids selected for the experiment were aqueous solutions of Xanthan gum and Polyacrylamide E10.

20731 (DOE/PC/92526–T6) **Rheology of coal-water slurries prepared by the HP roll mill grinding of coal: Quarterly technical progress report No. 6, December 1, 1993–February 28, 1994.** Fuerstenau, D.W. California Univ., Berkeley, CA (United States). Mar 1994. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92526. Order Number DE94013473. Source: OSTI; NTIS; GPO Dep.

The effect of the addition of nonionic surfactants on the aggregative stability of coal-water slurries was investigated through determination of sedimentation volumes and floc size distributions. Sedimentation volume measurements for nonionic surfactants show that for Triton X-165, Triton X-305 and Triton X-405, the sedimentation volume decreases slightly with added reagent up to 0.5 wt % addition, decreasing sharply for reagent additions between

0.5 to 0.75 wt %. However, at higher additions, the sedimentation volume levels off for Triton X-165, but increases for both Triton X-305 and Triton X-405. These results are in agreement with the viscosity measurements. Because of its plastic nature, bituminous coal is readily briquetted or agglomerated by the intense localized stresses encountered during comminution in the high-pressure roll mill. The degree of briquetting depends on the nature of the coal and the compressive stresses. We have found that the briquettes can readily be deagglomerated by stirring the comminuted products in a in methanol suspension. Our results show that the amount of minus 200-mesh coal produced depends mainly on the energy invested in the high-pressure roll grinding. The percentage of fines generated increases more or less linearly with the specific grinding energy consumed in the initial stages and tends to level off at the high energy inputs higher than 3 kwh/t. Even at 3.74 kWh/t of energy input, the ground product contained only 30 percent of minus 200-mesh particles, which is much lower than 80 percent of minus 200-mesh particles required in the coalwater slurries for direct combustion in power plants. Therefore, future work will encompass grinding of the high-pressure roll milled product in ball mill or rod mill, using hygrid HP roll mill/ball mill circuit for feed preparation.

20732 (DOE/PC/92530–T7) **Bed material agglomeration during fluidized bed combustion: Technical progress report, January 1, 1994–March 31, 1994.** Brown, R.C.; Dawson, M.R.; Smeenk, J.L. Ames Lab., IA (United States). Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92530. Order Number DE94013479. Source: OSTI; NTIS; GPO Dep.

Laboratory combustion tests conducted this quarter support the hypothesis that localized reducing conditions promote formation of agglomerates in the bed of fluidized bed boilers. These tests were designed to simulate localized reducing conditions found in commercial fluidized bed combustors. Localized reducing conditions may occur from either poor lateral bed mixing or oxygen-starved bed conditions due to the coal feed configuration. It was found-that agglomeration can occur at lower theoretical air values while operating temperatures are within the range of fluidized bed boilers. Cohesion of bed particles appears to take place very rapidly when theoretical air in the bed approaches 70%. These tests also indicate that bed temperature, pressure drop, oxygen and carbon dioxide concentrations are affected by agglomeration. Agglomeration appears to result in: (1) An increase in the frequency of pressure fluctuations (bed pressure drop). (2) An increase in the magnitude of pressure fluctuations (bed pressure drop.) (3) A possible decrease in bed pressure differential over time. In addition, there appears to be an increase in the amount of available oxygen and a decrease in CO_2. Agglomerates formed in the laboratory are being subjected to mineralogical analyses which will then be compared to similar analyses of agglomerates removed from commercial boilers.

20733 (DOE/PC/92548–T6) **Suppression of fine ash formation in pulverized coal flames: Quarterly technical progress report No. 6, January 1, 1994–March 31, 1994.** Kramlich, J.C.; Butcher, E.K.; Chenevert, B. Washington Univ., Seattle, WA (United States). Dept. of Mechanical Engineering. 30 Apr 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92548. Order Number DE94012600. Source: OSTI; NTIS; GPO Dep.

During the present quarter the model was coded and tested on the Illinois coal. Some features of the process need discussion. After devolatilization, the char particle heats towards its steady-state combustion temperature. At approximately 1200–1300 K, the particle quickly goes from a temperature where the equilibrium sodium vapor pressure is negligible to a temperature where it is at one atmosphere. This shows that the sodium vaporization occurs under non-isothermal conditions, although the rapid rate of sodium diffusion relative to particle heating suggests that the quasi steady-state formulation for the sodium vaporization portion of the problem is appropriate. It also illustrates the two-stage release pattern for the sodium: (1) an early rapid release of organically-bound sodium, and (2) a more delayed release of acid-washable sodium, and sodium that was complexed into clay chemicals during the organic sodium vaporization. The conditions reported for the present calculations are as follows: Coal: 8.7% ash, 12% H_2O, 33.5% volatile matter. Elemental sodium represent 0.82% of the ash. For purposes of calculation, the char particle is presumed to consist of the fixed carbon from the proximate analysis, along with the ash. This establishes the mass fraction of sodium and other minerals in the char at the start of char combustion. For the baseline condition, the char particle was assumed to be 50% covered by attached excluded mineral, and the included mineral matter was assumed to be divided into monodisperse 0.5 μm particles that are evenly dispersed throughout the char. The diameter of the char particle was 25 μm.

20734 (DOE/PC/93221–T2) **Combustion of pulverized coal in vortex structures: Quarterly progress report No. 2, January 1, 1994–March 31, 1994.** Gollahalli, S.R. Oklahoma Univ., Norman, OK (United States). School of Aerospace and Mechanical Engineering. Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93221. Order Number DE94012597. Source: OSTI; NTIS; GPO Dep.

This second quarterly report describes the activities and accomplishments of the research team at the University of Oklahoma, Norman, Oklahoma, related to the project entitled "Combustion of Pulverized Coal in Vortex Structures" during the period January 1, 1994 to March 31, 1994. The construction of the experimental facility for generating two-dimensional shear layers containing vortex structures has been completed. Preliminary shake-down test of the test facility were conducted for debugging and fine-tuning. A smoke generator was constructed for smoke-visualization of shear layers. Direct photographs of smoke flow patterns of the interfacial region of the mixing layers have been taken. Mean velocity profiles in the direction normal to the tunnel stream direction have been measured with a hot-wire anemometer for different ratios of the initial velocities of the mixing streams. In the next quarter, we plan to conduct schlieren flow visualization of the shear layer, fabricate the particulate feeding system, and measure the velocity field as a function of the particulate concentration in one of the streams.

20735 (SAND–94-8231) **Coal combustion science: Quarterly progress report, April 1993–June 1993.** Hardesty, D.R. (ed.). Sandia National Labs., Albuquerque, NM (United States). May 1994. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE94012412. Source: OSTI; NTIS; GPO Dep.

This document is a quarterly status report of the Coal Combustion Science Project that is being conducted at the Combustion Research Facility, Sandia National Laboratories. The information reported is for Apr-Jun 1993. The objective of this work is to support the Office of Fossil Energy in executing research on coal combustion science. This project consists of basic research on coal combustion that supports both the PETC Direct Utilization Advanced Research and Technology Development Program, and the International Energy Agency Coal Combustion Science Project. The objective of the kinetics and mechanisms of pulverized coal char combustion task is to characterize the combustion behavior of selected US coals under conditions relevant to industrial pulverized coal-fired furnaces. Work is being done in four areas: kinetics of heterogeneous fuel particle populations; char combustion kinetics at high carbon conversion; the role of particle structure and the char formation process in combustion and; unification of the Sandia char combustion data base. This data base on the high temperature reactivities of chars from strategic US coals will permit identification of important fuel-specific trends and development of predictive capabilities for advanced coal combustion systems. The objective of the fate of inorganic material during coal combustion task is the establish a quantitative understanding of the mechanisms and rates of transformation, fragmentation, and deposition of inorganic material during coal combustion as a function of coal type, particle size and temperature, the initial forms and distribution of inorganic species in the unreacted coal, and the local gas temperature and composition. In addition, optical diagnostic capabilities are being developed for in situ, real-time detection of inorganic vapor species and surface species during ash deposition. Selected papers have been indexed separately for inclusion in the Energy Science and Technology Database.

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 20684

20736 (DOE/EIA–0121(93/4Q)) **Quarterly coal report, October–December 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 19 May 1994. 154p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012516. Source: OSTI; NTIS; GPO Dep.

The United States produced 239 million short tons of coal in the fourth quarter of 1993, 11 million short tons less than in the fourth quarter of 1992 and the lowest fourth quarter level since 1986 (Table 1). This brought total coal production for 1993 to 944 million short tons, 54 million short tons less than in 1992(Table 4). The principal reasons for the drop in coal production in 1993 compared with 1992 were: a draw-down of electric utility coal stocks to meet the increase in demand for coal-fired electricity generation; a decrease in demand for US coal in foreign markets, particularly the steam coal markets; and a draw-down of producer/distributor stocks. Distribution of US coal in the fourth quarter of 1993 was 242 million short tons, a decline of 10 million short tons from distribution in the fourth quarter of 1992. US coal distribution in 1993 was 45 million short tons lower than in 1992, with 26 million short tons less distributed to foreign markets, and 19 million short tons less distributed to domestic markets (Table 9).

20737 (DOE/MC/10637–3703, pp. Paper 3, 10) **Regional Energy Policy Program for the northern Great Plains.** Daly, D.J. (Univ. of North Dakota, Grand Forks, ND (United States)). North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

The United States is the world's leading consumer of energy. The production and consumption of energy vary over the country as a function of climate, the availability of natural resources, economics, and culture. The northern Great Plains region (Montana, Wyoming, North Dakota, and South Dakota), an area characterized by many similarities in climate, culture, and physiography: (1) Accounts for over 10 percent of domestic hydrocarbon production; a major share of low-rank, low-sulfur coal production; and a significant amount of steam-generated electricity. (2) Contains significant oil shale, geothermal, nuclear, and conventional fossil fuel resources. (3) Contains significant research capability, particularly with regard to coal-conversion and oil shale technologies, and, with respect to the environmental effects of fossil fuel production, conversion and utilization. Is a net exporter of energy and fossil fuel materials. (4) Is a significant consumer of fuel and fossil fuel by-products in the agricultural sector. (5) Receives significant revenues and economic support from fossil fuel exploration, production, conversion, and transportation industries, as well as from ancillary industries.

0160 Health and Safety

20738 (DOE/MC/27246–3677) **Safer blasting agents and procedures for blasting in gassy non-coal mines: Final report, September 9, 1990–December 31, 1993.** Bureau of Mines, Pittsburgh, PA (United States). Pittsburgh Research Center. Dec 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI21-90MC27246. Order Number DE94004087. Source: OSTI; NTIS; GPO Dep.

Hundreds of tests have been conducted in the Bureau's Lake Lynn Laboratory Cannon Gallery to evaluate the incendivity characteristics of both commercially available and experimental explosive products. The cannon gallery test results have clearly identified several lower incendive explosives that can and have significantly reduced the gas and/or dust ignition hazards associated with blasting in non-coal mines. Several of the lower incendive explosive formulations have undergone full-scale field evaluations and, to date, had been very successful in preventing ignitions in base metal mines with high sulphur-bearing ore. Tests in the cannon gallery have shown that an inert gelled water material outperforms most other stemming agents in preventing the ignition of flammable gases and/or combustible dusts outside of the bore. A new water stemming plug was evaluated in the cannon gallery and shown to be a very effective stemming device. As a means to better evaluate explosive incendivity, the initial development of two instrument sensors are underway. A fiber optic rate probe has been redesigned to accurately measure the detonation velocity of explosives in the cannon bore. A photometric sensor is also under development to measure the peak temperatures of the detonation products exiting the bore. This report discusses the results of the research program including the test apparatus and procedures and summarizes the incendivity data obtained from the various explosives. Results from the full-scale field testing of the lower incendive products in an operating mine are then presented.

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 20745, 20758, 20759, 20760, 20762, 20763, 20764

20739 (DOE/BC/14448–11) **Reservoir heterogeneity in carboniferous sandstone of the Black Warrior basin: Final report.** Kugler, R.L.; Pashin, J.C.; Carroll, R.E.; Irvin, G.D.; Moore, H.E. Geological Survey, Tuscaloosa, AL (United States). Jun 1994. 191p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90BC14448. Order Number DE94000134. Source: OSTI; NTIS; GPO Dep.

Although oil production in the Black Warrior basin of Alabama is declining, additional oil may be produced through improved recovery strategies, such as waterflooding, chemical injection, strategic well placement, and infill drilling. High-quality characterization of reservoirs in the Black Warrior basin is necessary to utilize advanced technology to recover additional oil and to avoid premature abandonment of fields. This report documents controls on the distribution and producibility of oil from heterogeneous Carboniferous reservoirs in the Black Warrior basin of Alabama. The first part of the report summarizes the structural and depositional evolution of the Black Warrior basin and establishes the geochemical characteristics of hydrocarbon source rocks and oil in the basin. This second part characterizes facies heterogeneity and petrologic and petrophysical properties of Carter and Millerella sandstone reservoirs. This is followed by a summary of oil production in the Black Warrior basin and an evaluation of seven improved-recovery projects in Alabama. In the final part, controls on the producibility of oil from sandstone reservoirs are discussed in terms of a scale-dependent heterogeneity classification.

20740 (DOE/BC/14448–T5) **Reservoir heterogeneity in Carboniferous sandstone of the Black Warrior basin: Final report.** Kugler, R.L.; Pashin, J.C.; Carroll, R.E.; Irvin, G.D.; Moore, H.E. Alabama Geological Survey, Tuscaloosa, AL (United States). Apr 1994. 191p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90BC14448. Order Number DE94013153. Source: OSTI; NTIS; GPO Dep.

Although oil production in the Black Warrior basin of Alabama is declining, additional oil may be produced through improved recovery strategies, such as waterflooding, chemical injection, strategic well placement, and infill drilling. High-quality characterization of reservoirs in the Black Warrior basin is necessary to utilize advanced technology to recover additional oil and to avoid premature abandonment of fields. This report documents controls on the distribution and producibility of oil from heterogeneous Carboniferous reservoirs in the Black Warrior basin of Alabama. The first part of the report summarizes the structural and depositional evolution of the Black Warrior basin and establishes the geochemical characteristics of hydrocarbon source rocks and oil in the basin. This second part characterizes facies heterogeneity and petrologic and petrophysical properties of Carter and Millerella sandstone reservoirs. This is followed by a summary of oil production in the Black Warrior basin and an evaluation of seven improved-recovery projects in Alabama. In the final part, controls on the producibility of oil from sandstone reservoirs are discussed in terms of a scale-dependent heterogeneity classification.

20741 (DOE/BC/14649–15) **Analysis and evaluation of interwell seismic logging techniques for hydrocarbon reservoir characterization: Final report.** Parra, J.O.; Zook, B.J.; Sturdivant, V.R. Southwest Research Inst., San Antonio, TX (United States). Jun 1994. 194p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14649. Order Number DE94000133. Source: OSTI; NTIS; GPO Dep.

The work reported herein represents the third year work in evaluating high-resolution interwell seismic logging techniques for hydrocarbon reservoir characterization. The objective of this project is to investigate interwell seismic logging techniques for indirectly interpreting oil and gas reservoir geology and rock physical properties. The work involves a balanced study of theoretical and numerical modeling of seismic waves transmitted between pairs of wells combined with experimental data acquisition and processing at controlled field conditions. The field applications of this reservoir probing concept are aimed at demonstrating high resolution measurements and detailed interpretation of heterogeneous hydrocarbon-bearing formations. The first part of this third year project efforts was devoted to thoroughly evaluating interwell seismic logging and reverse VSP in a hydrocarbon-bearing formation at the Buckhorn test site in Illinois. Specifically, the data from the experiments conducted in the second year of this project were analyzed to delineate geological structures and to extract rock physical parameters. The second part of this project is devoted to the evaluation of continuity logging techniques for hydrocarbon reservoir continuity. Specifically, this part of the project includes the evaluation of methods of measurements, modeling and data processing to delineate the reservoir architecture and relate dispersion and attenuation measurements to rock physical properties.

20742 (IFP–41015) **Contribution of massively parallel architecture in petroleum exploration-production.** Piault, E. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Nice Univ., 06 (France). Nov 1993. 135p. (In French). Order Number DE94769957. Source: OSTI; NTIS (US Sales Only).

We propose some solutions to the parallelization of two different applications of great importance for the oil industry: wave propagation and oil reservoir simulations. We implement and optimize the solution of an acoustic wave propagation problem in heterogeneous media on the Connection Machine. Reaching high performance requires the use of sponge boundary conditions and bufferized I/O. A space-time domain decomposition method for out-core computations was designed and validated on the CM-2. We explored two opposite approaches for the parallelization of oil reservoir simulation. The first one consists in solving the equations in a fully explicit fashion. We present the explicit numerical scheme that we have designed for that purpose. The performance of this method on the CM-2, CM-5 and iPSC/860 are compared. The second approach requires a fully implicit scheme (in time). We propose a parallel solver and use domain decomposition methods to precondition the resolution of the linear systems involved. This solver, on a MIMD machine, is compared to the explicit approach above and to classical solvers.

20743 (IFP–41084) **Waves propagation and imaging in anisotropic media by ultra sonic laser.** Martin, D. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Paris-7 Univ., 75 (France). Dec 1993. 354p. (In French). Order Number DE94769956. Source: OSTI; NTIS (US Sales Only).

The aim of this thesis is the study of different effects of anisotropic elasticity on ultrasonic wave propagation and its consequences on imaging. The experimental set-up consists of a pulsed laser for the emission and a laser interferometer - or a piezoelectrical transducer- for the reception. In the first part, we characterize the directivity diagrams in emission and in reception. We also show the simultaneous occurrence of thermoelastic and ablation phenomena during ultrasonic generation on the surface of a solid. The second part presents the results of a comparison between an experimental and numerical modeling of a seismic prospecting experiment (cross-well). Then, we comment the results of an experimental characterization of different effects of anisotropy on wave propagation (bulk waves, interface waves and surface wave) such as the triplication effect of the quasi-transversal waves and the 'phonon focusing defocusing' effect in directions of symmetry. The third part shows the results of the modeling of seismic prospecting reflection experiments, in isotropic and anisotropic media. The effects of anisotropy on wave propagation and its influence on imaging using isotropic and anisotropic processing (migration) of the experimental data on a highly anisotropic rock (Angers Slate) are studied. We show the necessity of adopting an anisotropic algorithm to correctly reconstruct the different reflectors. If this is not done, the 'isotropically' reconstructed images mainly exhibit a loss of focusing (due to the choice of wrong migration velocities) and a mislocation of the reflectors (due to the fact that the rays and the wave normals are not colinear). In conclusion, we think this kind of experimental set-up is an outstanding research tool in physical modeling. But the poor sensitivity, weak dynamic range and difficulties of implementation mean that it is not as well adapted to the large scale experiments as conventional acoustic tanks.

20744 (IFP–41085) **Effect of water/gas saturation on acoustic properties of rocks. Study at sonic and ultrasonic frequencies.** Cadoret, T. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Paris-7 Univ., 75 (France). Dec 1993. 265p. (In French). Order Number DE94769955. Source: OSTI; NTIS (US Sales Only).

The aim of this thesis is to study the impact of air/water saturation on acoustic properties of rocks in different frequency ranges. Two different saturation techniques allow to obtain different fluid distributions. By using X-ray computed tomography of the samples, we can demonstrate the impact of saturation heterogeneity on acoustic phenomena. Experimental results obtained in all the frequency ranges show little dependence of shear wave properties on saturation. Velocities of longitudinal waves have been measured at sonic frequencies (1 kHz) with the resonant bar technique. In this case, the velocity vs. saturation relationship can be quantitatively modelled by Gassmann's equation when the partially saturated rock is perfectly homogeneous at a scale much smaller than the wavelength. However, when the saturation technique does not exhibit such homogeneity, the velocity vs. saturation evolution starts to deviate from the predictions of the model. Measurements done with intermediate frequencies (50 kHz-100 kHz) corroborate such analysis. The interpretation of results obtained at higher frequencies (500 kHz-1 MHz) is much less straightforward. At such frequencies, new intrinsic and extrinsic mechanisms can occur simultaneously.

0203 Drilling and Production

Refer also to citation(s) 20738, 20739

20745 (DOE/BC–93/3) **Contracts for field projects and supporting research on enhanced oil recovery. Progress review No. 75: Progress review quarter ending, April 1, 1993–June 30, 1993.** Seright, R.S.; Martin, F.D. USDOE Bartlesville Project Office, OK (United States). Jun 1994. 162p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94000115. Source: OSTI; NTIS; GPO Dep.

This DOE report summarizes the efforts of contractors in the area of enhanced oil recovery. Progress in various areas including well engineering, flooding methods, gas displacement thermal recovery, microbial technologies, and surfactant-assisted methods were presented. In addition, well diagnostic and reservoir characterization are discussed.

20746 (DOE/BC/14831–8) **Assist in the recovery of bypassed oil from reservoirs in the Gulf of Mexico: Annual summary report, February 18, 1993–February 18, 1994.** Schenewerk, P.A. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Petroleum Engineering. 17 Mar 1994. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14831. Order Number DE94013953. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to assist the recovery of noncontacted oil from known reservoirs on the outer Continental Shelf in the Gulf of Mexico. Thus far, research has consisted of data collection from Minerals Management Service (MMS), literature and operators; detailed studies of several screened reservoirs; modification of three public domain simulators; development of a

predictive model; and design and construction of several laboratory experiments for studying attic oil recovery. The methodology for data collection from MMS, literature and operators is keyed on 208 sands containing 1,289 reservoirs, representing 60% of the original oil in place (OOIP) in the Gulf of Mexico. This data collection has been completed. Secondary recovery by downdip gas injection in steeply dipping oil reservoirs has been widely used successfully since the 1950's. Methane and nitrogen have been the primary gases used. Reservoirs which had been subjected to this type of recovery or had the potential to be subjected to this type of recovery were screened for detailed studies. Three reservoirs were identified which possessed the proper criteria and which had data available for detailed studies. Detailed data sets for simulating these reservoirs were created. History matching and prediction runs have been completed. Modifications on three public domain computer reservoir simulators, BOAST II mainframe, BOAST II PC and MASTER, were underway. Laboratory investigations continued but were slowed by several unforeseen incidences involving broken apparatus and inability to receive parts due to the California earthquake.

20747 (DOE/BC/14852–4) **Scale-up of miscible flood processes: Quarterly report, July 1, 1993–September 30, 1993.** Orr, F.M. Jr. Stanford Univ., CA (United States). Dept. of Petroleum Engineering. [1993]. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14852. Order Number DE94013925. Source: OSTI; NTIS; GPO Dep.

Progress is reported for a comprehensive investigation of the scaling behavior of gas injection processes in heterogeneous reservoirs. The interplay of phase behavior, viscous fingering, gravity segregation, capillary imbibition and drainage, and reservoir heterogeneity is examined in a series of simulations and experiments. Compositional and first-contact miscible simulations of viscous fingering and gravity segregation are compared to show that the two techniques can give very different results. Also, analyzed are two-dimensional and three-dimensional flows in which gravity segregation and viscous fingering interact. The simulations show that 2D and 3D flows can differ significantly. A comparison of analytical solutions for three-component two-phase flow with experimental results for oil/water/alcohol systems is reported. While the experiments and theory show reasonable agreement, some differences remain to be explained. The scaling behavior of the interaction of gravity segregation and capillary forces is investigated through simulations and through scaling arguments based on analysis of the differential equations. The simulations show that standard approaches do not agree well with results of low IFT displacements. The scaling analyses, however, reveal flow regimes where capillary, gravity, or viscous forces dominate the flow.

20748 (DOE/BC/14852–5) **Scale-up of miscible flood processes for heterogeneous reservoirs: 1993 annual report.** Orr, F.M. Jr. Stanford Univ., CA (United States). Dept. of Petroleum Engineering. May 1994. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14852. Order Number DE94000130. Source: OSTI; NTIS; GPO Dep.

Progress is reported for a comprehensive investigation of the scaling behavior of gas injection processes in heterogeneous reservoirs. The interplay of phase behavior, viscous fingering, gravity segregation, capillary imbibition and drainage, and reservoir heterogeneity is examined in a series of simulations and experiments. Compositional and first-contact miscable simulations of viscous fingering and gravity segregation are compared to show that the two techniques can give very different results. Also, analyzed are two-dimensional and three-dimensional flows in which gravity segregation and viscous fingering interact. The simulations show that 2D and 3D flows can differ significantly. A comparison of analytical solutions for three-component two-phase flow with experimental results for oil/water/alcohol systems is reported. While the experiments and theory show reasonable agreement, some differences remain to be explained. The scaling behavior of the interaction of gravity segregation and capillary forces is investigated through simulations and through scaling arguments based on analysis of the differential equations. The simulations show that standard approaches do not agree well with results of low IFT displacements. The scaling analyses, however, reveal flow regimes where capillary, gravity, or viscous forces dominate the flow.

20749 (DOE/BC/14852–7) **Scale-up of miscible flood processes for heterogeneous reservoirs: Quarterly report, 1 January–31 March 1994.** Orr, F.M. Jr. Stanford Univ., CA (United States). Dept. of Petroleum Engineering. Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14852. Order Number DE94013924. Source: OSTI; NTIS; GPO Dep.

The current project is a systematic research effort aimed at quantifying relationships between process mechanisms that can lead to improved recovery from gas injection processes performed in heterogeneous Class 1 and Class 2 reservoirs. It will provide a rational basis for the design of displacement processes that take advantage of crossflow due to capillary, gravity and viscous forces to offset partially the adverse effects of heterogeneity. In effect, the high permeability zones are used to deliver fluid by crossflow to zones that would otherwise be flooded only very slowly. Thus, the research effort is divided into five areas: Development of miscibility in multicomponent systems; design estimates for nearly miscible displacements; design of miscible floods for fractured reservoirs; compositional flow visualization experiments; simulation of near-miscible flow in heterogeneous systems. The status of the research effort in each area is reviewed briefly in the following section. From this work, we can make the following conclusions: (1) We demonstrated theoretically and experimentally that a linear combination of gravity and viscous forces can be used to correlate residual nonwetting phase saturations for both gravity-favorable and gravity-unfavorable displacements. (2) When gravity forces are comparable to or larger than the viscous forces) gravity unfavorable displacements have significantly higher residual nonwetting phase saturation than gravity-favorable displacements. (3) Because soils have much higher permeabilities than oil reservoirs, gravity effects on residual nonwetting phase saturations are much more significant in spilled-oil clean-up than in oil recovery processes. (4) The effective correlation length for a percolation process can be related to a linear combination of the gravity and viscous forces.

20750 (DOE/BC/14853–8) **Continued support of "The Natural Resources Information System (NRIS) for the State of Oklahoma": Quarterly technical progress report, January 1, 1994–March 31, 1994.** Mankin, C.J. (Oklahoma Geological Survey, Norman, OK (United States)); Rizzuti, T.P. Oklahoma Univ., Norman, OK (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14853. Order Number DE94013901. Source: OSTI; NTIS; GPO Dep.

The objective of this research program is to continue developing, editing, maintaining, utilizing and making publicly available the Oil and Gas Well History file portion of the Natural Resources Information System (NRIS) for the State of Oklahoma. The Oklahoma Geological Survey, working with Geological Information Systems at the University of Oklahoma Sarkeys Energy Center, has undertaken to construct this information system in response to the need for a computerized, centrally located library containing accurate, detailed information on the state's natural resources. Particular emphasis during this phase of NRIS development is being placed on computerizing information related to the energy needs of the nation, specifically oil and gas. The NRIS Well History file contains historical and recent completion records for oil and gas wells reported to the Oklahoma Corporation Commission on Form 1002-A. At the start of this quarter, the Well History file contained 355,873 records, providing geographical coverage for most of Oklahoma (all but Osage County). Data elements on this file include API well number, lease name and well number, location information, elevations, dates of significant activities for the well and formation items (e.g., formation names, completion and test data, depths and perforations). In addition to the standard Well History file processing, special projects are undertaken to add supplemental data to the file from well logs, scout tickets, and core and sample documentation.

20751 (DOE/BC/14861–3) **Horizontal oil well applications and oil recovery assessment: Technical progress report, January–March 1994.** McDonald, W.J. Maurer Engineering, Inc., Houston, TX (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-93BC14861. Order Number DE94013904. Source: OSTI; NTIS; GPO Dep.

The primary objective of this project is to examine factors affecting technical and economic success of horizontal well applications. The project's goals will be accomplished through five tasks designed to evaluate the technical and economic success of horizontal drilling, highlight current limitations, and outline technical needs to overcome these limitations. Data describing operators' experiences throughout the domestic oil and gas industry will be gathered and organized. MEI databases containing detailed horizontal case histories will also be used. All these data will be categorized and analyzed to assess the status of horizontal well technology and estimate the impact of horizontal wells on present and future domestic oil recovery and reserves. Accomplishments for this quarter are presented.

20752 (DOE/BC/14862–4) **Productivity and injectivity of horizontal wells: Quarterly report, January 1, 1994–March 31, 1994.** Fayers, F.J.; Aziz, K.; Hewett, T.A. Stanford Univ., CA (United States). Dept. of Petroleum Engineering. [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14862. Order Number DE94013905. Source: OSTI; NTIS; GPO Dep.

During the last three months we have studied coning and cresting behavior in horizontal and vertical wells using the commercial simulator, Eclipse. In our second quarterly report we compared the predications of five analytical methods for critical rates and presented the results in a table for a gas-cresting example problem. In this quarterly report, wee present simulation results for the coning and cresting critical rates for vertical and horizontal wells.

20753 (DOE/BC/14864–6) **Study of hydrocarbon miscible solvent slug injection process for improved recovery of heavy oil from Schrader Bluff Pool, Milne Point Unit, Alaska: Annual report, December 1, 1992–December 31, 1993.** Sharma, G.D. Alaska Univ., Fairbanks, AK (United States). Petroleum Development Lab. Jan 1994. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14864. Order Number DE94013906. Source: OSTI; NTIS; GPO Dep.

The shallow Cretaceous sands of the Schrader Bluff Reservoir occur between depths of 4,000 and 4,800 feet below surface and are estimated to contain up to 1.5 billion barrels of oil in place. The field is currently under production by primary depletion. Initial production indicated that primary recovery will fall short of earlier estimates and waterflooding will have to be employed much earlier than expected. A large portion of the oil-in-place thus would still be left behind in this reservoir after primary and secondary recovery methods have been applied. Enhanced oil recovery (EOR) techniques will be needed to recover the additional portion of remaining oil in this huge reservoir and to add significant additional reserves. Slim tube displacement studies, PVT data and asphaltene precipitation studies are needed for Schrader Bluff heavy oil to define possible hydrocarbon solvent suitable for miscible solvent slug displacement process. Such studies are essential because the API gravity of the crude in Schrader Bluff reservoir varies significantly from well to well. Coreflood experiments are also needed to determine effect of solvent slug size, WAG ratio and solvent composition on the oil recovery and solvent breakthrough. A compositional reservoir simulation study will be conducted later to evaluate the complete performance of the hydrocarbon solvent slug process and to assess the feasibility of this process for improving recovery of heavy oil from Schrader Bluff reservoir. This report contains the following: reservoir description; slim tube displacement studies; and coreflood experiments.

20754 (DOE/BC/14864–7) **Study of hydrocarbon miscible solvent slug injection process for improved recovery of heavy oil from Schrader Bluff Pool, Milne Point Unit, Alaska: [Quarterly] report, January 1, 1994–March 31, 1994.** Sharma, G.D. Alaska Univ., Fairbanks, AK (United States). Petroleum Development Lab. [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14864. Order Number DE94013907. Source: OSTI; NTIS; GPO Dep.

The ultimate objective of this three-year research project is to evaluate the performance of the hydrocarbon miscible solvent slug process and to assess the feasibility of this process for improving recovery of heavy oil from Schrader Bluff reservoir. This will be accomplished through measurement of PVT and fluid properties of Schrader Bluff oil, determination of phase behavior of Schrader Bluff oil solvent mixtures, asphaltene precipitation tests, slim tube displacement tests, core flood experiments and reservoir simulation studies. The expected results from this project include: determination of optimum hydrocarbon solvent composition suitable for hydrocarbon miscible solvent slug displacement process, optimum slug sizes of solvent needed, solvent recovery factor, solvent requirements, extent and timing of solvent recycle, displacement and sweep efficiency to be achieved and oil recovery. During this quarter, more displacement experiments in slim tube and miscible coreflood experiments have been conducted. Also, work has been initiated to match the slim tube displacement results using GEM, a compositional simulator developed by Computer Modelling Group.

20755 (DOE/BC/14875–2) **Research program on fractured petroleum reservoirs: Fourth quarterly report, October 1–December 31, 1993.** Firoozabadi, A. Reservoir Engineering Research Inst., Palo Alto, CA (United States). 31 Jan 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14875. Order Number DE94013909. Source: OSTI; NTIS; GPO Dep.

Progress reports are presented for project 2-supersaturation, critical saturation and residual gas saturation in porous media and for project 5-simulation of fractured reservoirs. Under project 2, a visual high-pressure core-holder has been designed and constructed to be used in critical gas saturation and some other measurements. The apparatus has been used to measure critical gas saturation for a low viscosity mixture. These measurements reconfirm the investigators' previously published data that critical gas saturation for low viscosity fluids are low-around 1 percent. The apparatus is being currently used to measure critical gas saturation of an 11 API oil. Unlike light oils, heavy oil reservoirs, especially fractured heavy oil reservoirs might have an extremely high recovery efficiency with solution gas-drive. The critical gas saturation is an important element of recovery efficiency for such reservoirs.

20756 (DOE/BC/14875–3) **Research program on fractured petroleum reservoirs: First quarterly report, January 1–March 31, 1994.** Firoozabadi, A. Reservoir Engineering Research Inst., Palo Alto, CA (United States). 30 Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14875. Order Number DE94013908. Source: OSTI; NTIS; GPO Dep.

Critical gas saturation and solution gas drive performance of a heavy oil (μ_0 = 17,000 cp) in a Berea core sample was measured. The critical gas saturation is less than 1.5 percent. But, the solution gas drive process for the heavy oil, unlike the light oil, is very efficient. While reducing the system pressure from a bubble point pressure of 445 psia to a pressure of 330 psia, 11 percent of the oil was produced from the core. In view of the high recovery due to solution gas drive, a duplicate experiment is being conducted. The pressure will be lowered to near 50 psia in the duplicate experiment.

20757 (DOE/BC/14882–7) **Responsive copolymers for enhanced petroleum recovery: Quarterly technical progress report, December 22, 1993–March 21, 1994.** McCormick, C.; Hester, R. University of Southern Mississippi, Hattiesburg, MS (United States). Dept. of Polymer Science. [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14882. Order Number DE94013911. Source: OSTI; NTIS; GPO Dep.

The overall goal of this research is the development of advanced water-soluble copolymers for use in enhanced oil recovery. This report summarizes technical progress for the following tasks: advanced copolymer synthesis; and characterization of molecular structure of copolymers.

20758 (DOE/BC/14884–7) **Surfactant loss control in chemical flooding: Spectroscopic and calorimetric study of adsorption and precipitation on reservoir minerals: Quarterly technical progress report, October 1, 1993–December 31, 1993.** Somasundaran, P. Columbia Univ., New York, NY (United States). Lowell Memorial Library. 22 Feb 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14884. Order Number DE94013913. Source: OSTI; NTIS; GPO Dep.

The aim of this contract is to elucidate the mechanisms underlying adsorption and surface precipitation of flooding surfactants on reservoir minerals. Effect of surfactant structure, surfactant combinations and other inorganic and polymeric species and solids of relevant mineralogy will also be determined. A multi-pronged approach consisting of micro & nano spectroscopy, microcalorimetry, electrokinetics, surface tension and wettability win be used to achieve the goals. The results of this study should help in controlling surfactant loss in chemical flooding and also in developing optimum structures and conditions for efficient chemical flooding processes. Adsorption/desorption of tetradecyl trimethyl ammonium chloride (TTAC) and sodium dodecyl sulfate (SDS)/octaethylene glycol mono n-decyl ether ($C_{12}EO_8$) surfactant mixtures at the kaolinite-water and alumina-water interfaces was studied during this quarter. The microstructure of the adsorbed layer was investigated using spectroscopic techniques. Effect of the hydrocarbon chain length of octaethylene glycol mono n-alkyl ether (C_nEO_8) type nonionic surfactants on the adsorption of 1:1 mixtures of sodium dodecyl sulfate (SDS)/C_nEO_8 at the kaolinite/water interface was studied. The adsorption of SDS was enhanced by the presence of $C_{10}EO_8$ but this effect was not as significant as those by $C_{12--16}EO_8$. Interestingly, once the hydrocarbon chain length of the nonionic surfactant exceeded that of the SDS (12) there was no further enhancement of SDS adsorption.

20759 (DOE/BC/14894–2) **Application of artificial intelligence to reservoir characterization: An interdisciplinary approach: [Quarterly progress report], January 1–March 31, 1994.** Kelkar, B.G.; Gamble, R.F.; Kerr, D.R.; Thompson, L.G.; Shenoi, S. Tulsa Univ., OK (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-93BC14894. Order Number DE94013889. Source: OSTI; NTIS; GPO Dep.

The basis of this research is to apply novel techniques from Artificial Intelligence and Expert Systems in capturing, integrating and articulating key knowledge from geology, geostatistics, and petroleum engineering to develop accurate descriptions of petroleum reservoirs. The ultimate goal is to design and implement a single powerful expert system for use by small producers and independents to efficiently exploit reservoirs. The overall project plan to design the system to create integrated reservoir descriptions begins by initially developing an AI-based methodology for producing large-scale reservoir descriptions generated interactively from geology and well test data. Parallel to this task is a second task that develops an AI-based methodology that uses facies-biased information to generate small-scale descriptions of reservoir properties such as permeability and porosity. The third task involves consolidation and integration of the large-scale and small-scale methodologies to produce reservoir descriptions honoring all the available data. The final task will be technology transfer. With this plan, we have carefully allocated and sequenced the activities involved in each of the tasks to promote concurrent progress towards the research objectives. Moreover, the project duties are divided among the faculty member participants. Graduate students will work in teams with faculty members. The results of the integration are not merely limited to obtaining better characterizations of individual reservoirs. They have the potential to significantly impact and advance the discipline of reservoir characterization itself.

20760 (DOE/BC/14950–6) **Enhanced oil recovery utilizing high-angle wells in the Frontier Formation, Badger Basin Field, Park County, Wyoming: Quarterly technical progress report, 1 January 1994–31 March 1994.** Fortmann, R.G. Sierra Energy Co., Cody, WY (United States). 22 Apr 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14950. Order Number DE94013894. Source: OSTI; NTIS; GPO Dep.

Sierra Energy Company, in consultation with Rim Companies, concluded that additional work was required for Subtask 2.1.4 – Interpret data, of Task 2.1 - Acquire 3-D seismic data. The goal of this subtask was to interpret the 3-D seismic data, using a workstation, in order to locate the surface and subsurface positions for the slant and horizontal wellbores. Although this goal had been reached, more work was needed for plotting maps and seismic sections. Furthermore, it was determined that an additional look at the amplitude distribution in the Frontier sands would greatly benefit the interpretation.

20761 (DOE/BC/14951–6) **Integrated approach towards the application of horizontal wells to improve waterflooding performance: [Quarterly] report, January 1–March 31, 1994.** Kelkar, B.G.; Liner, C.; Kerr, D. Tulsa Univ., OK (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14951. Order Number DE94013895. Source: OSTI; NTIS; GPO Dep.

The overall purpose of the proposed project is to improve secondary recovery performance of a marginal oil field through the use of a horizontal injection well. The location and direction of the well will be selected based on the detailed reservoir description using integrated approach. We expect that 2 to 5% of original oil in place will be recovered using this method. To accomplish the goals of the project, it is divided into two stages. In Stage 1, we will select part of the Glenn Pool field (William B. Self Unit), and collect additional reservoir data by conducting cross bore hole tomography surveys and formation micro scanner logs through newly drilled well. In addition, we will also utilize analogous outcrop data. By combining the state of the art data with conventional core and log data, we will develop a detailed reservoir description based on integrated approach. After conducting extensive reservoir simulation studies, we will select a location and direction of a horizontal injection well. The well will be drilled based on optimized design, and the field performance will be monitored for at least six months. If the performance is encouraging, we will enter into second budget period of the project. As discussed in the last quarterly report, based on the preliminary flow simulation studies and the feasibility of obtaining reliable cross well seismic data, Well No. 82 was drilled at the end of December 1993. This progress report is divided into three sections. In the first section, we discuss the preliminary geological description of Self No. 82 which was drilled in the Self Unit. In the second section, we discuss the preliminary results based on the cross bore hole seismic surveys. In the last section, we present additional results of a well test conducted on Well No. 54 and comparison of the well test permeability with the permeability data from Well No. 82.

20762 (DOE/BC/14952–6) **Secondary oil recovery from selected Carter sandstone oilfields, Black Warrior basin, Alabama: [Annual] yearly report, December 1, 1992–November 30, 1993.** Anderson, J.C. Anderman/Smith Operating Co., Denver, CO (United States). 1 Mar 1994. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14952. Order Number DE94013896. Source: OSTI; NTIS; GPO Dep.

In this Class I PON, Anderman/Smith Operating Company is targeting three Carter sandstone oilfields (Black Warrior basin) for secondary recovery. Waterfloods are underway in two of the areas – Central Bluff and North Fairview units. For the third area, South Bluff, negotiations are underway to unitize the field. Once South Bluff is unitized, waterflooding will commence.

20763 (DOE/BC/14959–5) **Revitalizing a mature oil play: Strategies for finding and producing unrecovered oil in Frio Fluvial-Deltaic reservoirs of South Texas: Annual report, October 1992–October 1993.** McRae, L.E.; Holtz, M.H.; Knox, P.R. Texas Univ., Austin, TX (United States). Bureau of Economic Geology. May 1994. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14959. Order Number DE94000131. Source: OSTI; NTIS; GPO Dep.

The Frio Fluvial-Deltaic Sandstone (Vicksburg Fault Zone) oil play of South Texas has produced nearly 1 Bbbl of oil, yet still contains about 1.6 Bbbl of unrecovered mobile oil and nearly the same amount of residual oil resources. More than half of the reservoirs in this depositionally complex play have been abandoned, and large volumes of oil may remain unproduced unless advanced characterization techniques are applied to define untapped, incompletely drained, and new pool reservoirs as suitable targets for near-term recovery. Interwell-scale geological fades models of Frio fluvial-deltaic reservoirs will be combined with engineering assessments and geophysical evaluations in order to characterize Frio fluvial-deltaic reservoir architecture and flow unit boundaries and to determine the controls that these characteristics exert on the location and volume of unrecovered mobile and residual oil. These

results will help identify specific opportunities to exploit these heterogeneous reservoirs for incremental recovery by recompletion and strategic infill drilling. Preliminary syntheses of reservoir log, core, and production data were undertaken to identify individual reservoirs with the greatest additional resource potential to target for detailed reservoir characterization studies. Representative logs for each field were selected to characterize overall depositional style and illustrate reservoir zones and associated production. Core analysis data from both fields were tabulated, summarized, and evaluated by reservoir to identify and assess reservoir variability within the field. Production histories for individual reservoirs were reconstructed using available completion data. On the basis of these preliminary investigations and a general assessment of reserve growth potential of reservoirs within each field area, reservoir intervals from Rincon and T-C-B fields have been targeted for detailed characterization studies.

20764 (DOE/BC/14959–7) **Revitalizing a mature oil play: Strategies for finding and producing unrecovered oil in Frio Fluvial-Deltaic reservoirs of South Texas: Technical progress report, January 1, 1994–March 31, 1994.** Tyler, N.; Dutton, S. Texas Univ., Austin, TX (United States). Bureau of Economic Geology. 31 Mar 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14959. Order Number DE94013640. Source: OSTI; NTIS; GPO Dep.

Advanced reservoir characterization techniques are being applied to selected reservoirs in the Frio Fluvial-Deltaic Sandstone (Vicksburg Fault Zone) trend of South Texas in order to maximize the economic producibility of resources in this mature oil play. More than half of the reservoirs in this depositionally complex play have already been abandoned, and large volumes of oil may remain unproduced unless advanced characterization techniques are applied to define untapped, incompletely drained, and new pool reservoirs as suitable targets for near-term recovery methods. This project is developing interwell-scale geological fades models and assessing engineering attributes of Frio fluvial-deltaic reservoirs in selected fields in order to characterize reservoir architecture, flow unit boundaries, and the controls that these characteristics exert on the location and volume of unrecovered mobile and residual oil. The results of these studies will lead directly to the identification of specific opportunities to exploit these heterogeneous reservoirs for incremental recovery by recompletion and strategic infill drilling. Project work during this first quarter of 1994 consisted of the continuation of Phase 2 tasks associated with identification and delineation of incremental recovery opportunities in selected Frio fluvial-deltaic sandstone reservoirs. The present focus has been on defining interwell stratigraphic heterogeneity of individual reservoir zones in Rincon field through detailed stratigraphic correlations and analysis of abundant wireline core data.

20765 (DOE/BC/14959–8) **Identification of remaining oil resource potential in the Frio Fluvial/Deltaic Sandstone play, South Texas.** Holtz, M.H.; McRae, L.E.; Tyler, N. Texas Univ., Austin, TX (United States). Bureau of Economic Geology. May 1994. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14959. Order Number DE94000132. Source: OSTI; NTIS; GPO Dep.

The Frio Fluvial/Deltaic Sandstone (Vicksburg Fault Zone) oil play of South Texas has produced nearly 1 billion stock tank barrels (BSTB) of oil, yet still contains about 1.2 BSTB of unrecovered mobile oil and an even greater amount of residual oil resources (1.5 BSTB). More than half of the reservoirs in this depositionally complex play have been abandoned, and large volumes of oil may remain unproduced. Interwell-scale geological facies models of Frio fluvial/deltaic reservoirs will be combined with engineering assessments and geophysical evaluations in order to characterize Frio fluvial/deltaic reservoir architecture, flow unit boundaries, and the controls that these characteristics exert on the location and volume of unrecovered mobile and residual oil. Reservoir attribute data were statistically analyzed from oil and gas fields throughout the geographic area covered by the Frio Fluvial/Deltaic Sandstone oil play. General reservoir attributes analyzed in detail included porosity, initial water saturation, residual oil saturation, net pay, reservoir area, and fluid characteristics. Statistical analysis of variance demonstrated no difference between oil reservoir attributes and gas reservoir attributes. Probability functions that describe attribute frequency distributions were determined for use in risk adjusting resource calculations. The oil play was found to contain significant volumes of remaining oil. The volumetric probability distribution between 5- and 95-percent probability for original oil in place ranges from 3.8 to 5.6 BSTB, original mobile oil in place ranges from 2.5 to 3.6 BSTB, and residual oil ranges from 1.5 to 2.3 BSTB. The untapped oil resource may be 10 percent of the original oil in place, or 380 million stock tank barrels.

20766 (DOE/BC/14960–4) **Post waterflood CO_2 miscible flood in light oil, fluvial: Dominated deltaic reservoirs: Second quarterly technical progress report, Fiscal year 1994, January 1, 1994–March 31, 1994.** Texaco Exploration and Production, Inc., Bridge City, TX (United States). 29 Apr 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14960. Order Number DE94013639. Source: OSTI; NTIS; GPO Dep.

Production resumed from the Port Neches CO_2 project on December 6, 1993, after a 75 days shut in period. Since that date production is continuing to improve on various wells that responded to CO_2 injection. Current production is averaging 325 BOPD from 3 wells. This represents 4 folds increase from the production level prior to commencing CO_2 injection. Texaco continue to purchase an average of 4.3 MMCF/D of CO_2 from Cardox. The reservoir pressure increased with CO_2 injection from 2460 psi in September 1993 to 3328 psi in January 1994. However, the reservoir pressure declined slightly since then to 2730 psi in March of this year because of reservoir imbalance due to downtime at the CO_2 source. Currently, CO_2 is being injected in 3 wells in the reservoir including the horizontal well drilled specifically for this purpose. The well, through its 250 ft horizontal section, is capable of taking all the available CO_2 volume. However, injection rate in the well is restricted in order to distribute the CO_2 evenly in the reservoir. Texaco is continuing its efforts to transfer this technology to other operators by presenting two papers at the SPE/DOE symposium that was hold on April 17–20, 1994, in Tulsa, Oklahoma. One paper will discuss reservoir characterization and project design, while the other paper will discuss the development of the screening model. This model is scheduled for release to the public in 1994, it will be a very useful screening and design tool for the industry. A topical report covering the environmental regulations and constrains related to the implementation of similar projects, will be released later this year.

20767 (DOE/MC/30127–3725) **Jointly sponsored research program: Quarterly technical progress report, October–December 1993.** Deans, H.A. Western Research Inst., Laramie, WY (United States). [1994]. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-93MC30127. (WRI–94-R005). Order Number DE94012063. Source: OSTI; NTIS; GPO Dep.

This is a progress report on work performed by Western Research Institute for the U.S. DOE, Morgantown Energy Technology Center in the period October- December 1993. Tasks addressed include: development and demonstration of a practical electric downhole steam generator for thermal recovery of heavy oil and tar; wetting behavior of selected crude oil/brine/rock systems; coal gasification, power generation, and product market study; the impact of leachate from clean coal technology waste on the stability of clay liners; investigation of coprocessing of heavy oil, automobile shredder residue, and coal; injection into coal seams for simultaneous CO_2 mitigation and enhanced recovery of coalbed methane; optimization of carbonizer operations in the FMC coke process; chemical sensor and field screening technology development; demonstration of the koppelman "series c" process using a batch test unit with Powder River Basin coal as feed; remote chemical sensor development; market assessment and technical feasibility study of PFBC ash use; solid-state NMR analysis and interpretation of naturally and artificially matured kerogens; Crow™ field demonstration with bell lumber and pole; "B" series pilot plant tests; in situ treatment of manufactured gas plant contaminated soils demonstration program.

20768 (DOE/MT/92012–2) **Evaluation of using cyclocranes to support drilling and production of oil and gas in Wetland**

Areas: Fourth quarterly report, [October–December 1992]. Eggington, W.J. Mission Research Corp., San Diego, CA (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92012. Order Number DE94013935. Source: OSTI; NTIS; GPO Dep.

The planned program falls under wetlands area research related to drilling, production, and transportation of oil and gas resources. Specifically the planned program addresses an evaluation of using cyclocraft to transport drill rigs, mud, pipes and other materials and equipment in a cost effective and environmentally safe manner to support oil and gas drilling and production operations in wetland areas. During the.reporting period, a report that contained the results of each of the five subtasks that comprise Task 1, Environmental Considerations, was prepared and submitted to DOE. The subtasks were an overview of oil and gas activities in wetlands; a review of present wetland access practices; identification of past environmental impacts experienced; definition of marsh habitat considerations and discussion of forested wetland considerations. In Task 2, Transport Requirements, a report on the acquisition of data on the transport requirements to support oil and gas drilling and production operations in Wetland Areas was prepared and submitted to DOE. Task 3, Parametric Analysis, was completed during the reporting period. The analysis showed that a cyclocraft, having a payload capacity of 45 tons, was the most economic and would be able to transport all of the required equipment and materials. The final report on the parametric analysis was to be submitted in January, 1993.

20769 (IFP–41145) **Gellan: Influence of the fermentor hydrodynamics on its production, its physico-chemical characteristics and its possibilities of appliance in drilling fluids.** Dreveton, E. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Institut National Polytechnique, 54 - Nancy (France). Jan 1994. 191p. (In French). Order Number DE94769952. Source: OSTI; NTIS (US Sales Only).

Gellan gum is a new bacterial polysaccharide exhibiting interesting properties. This study deals with the effect of fermentor hydrodynamics on production, physico-chemical characteristics and potentialities of this biopolymer in non polluting well drilling fluids. The crucial role of oxygen transfer on gellan production was clearly shown by fermentations carried out with three impeller systems generating different macromixing patterns, or with nitrogen limitation or extra oxygen supply. In addition, understanding of the physiology of gellan synthesis was improved. Furthermore, the more homogeneous the macromixing conditions, the higher the molecular weight of the polysaccharide. Besides, no effect of oxygen transfer on gellan molecular weight was observed whereas oxygen limited conditions led to an increase of the esterification degree of the polymer. Finally, native gellan gum displayed thixotropic and fluid loss control properties and thereby seems to be a very interesting polymer for water-based well drilling fluids. For this application, performances obtained with gellan are similar to those of the widely used semi-synthetic polymer CMC. Moreover, gellan was less sensitive to the presence of divalent cations and led to more thixotropic fluids.

20770 (LBL–35262) **Chemical flooding in a virtual environment - a survivor's guide to VR development.** Bethel, W. Lawrence Berkeley Lab., CA (United States). Mar 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9405139–2: 1994 international American Vacuum Society users conference, Boston, MA (United States), 2-4 May 1994). Order Number DE94011909. Source: OSTI; NTIS; GPO Dep.

Building something which could be called "virtual reality" (VR) is something of a challenge, particularly when nobody really seems to agree on a definition of VR. The author wanted to combine scientific visualization with VR, resulting in an environment useful for assisting scientific research. He demonstrates the combination of VR and scientific visualization in a prototype application. The VR application constructed consists of a dataflow based system for performing scientific visualization (AVS), extensions to the system to support VR input devices and a numerical simulation ported into the dataflow environment. The VR system includes two inexpensive, off-the-shelf VR devices and some custom code. A working system was assembled with about two man-months of effort. The system allows the user to specify parameters for a chemical flooding simulation as well as some viewing parameters using VR input devices, as well as view the output using VR output devices. In chemical flooding, there is a subsurface region that contains chemicals which are to be removed. Secondary oil recovery and environmental remediation are typical applications of chemical flooding. The process assumes one or more injection wells, and one or more production wells. Chemicals or water are pumped into the ground, mobilizing and displacing hydrocarbons or contaminants. The placement of the production and injection wells, and other parameters of the wells, are the most important variables in the simulation.

0204 Processing

Refer also to citation(s) 20641, 20642, 20766, 22089

20771 (ANL/ES/PROC–82986) **Summary of the proceedings of the workshop on the refinery of the future.** Argonne National Lab., IL (United States). [1994]. 274p. Sponsored by USDOE, Washington, DC (United States);National Petroleum Refiners Association, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940281–: Workshop on the refinery of the future, Houston, TX (United States), 14-15 Feb 1994). Order Number DE94013319. Source: OSTI; NTIS; GPO Dep.

This report on the Workshop on the Refinery of the Future has been prepared for participants to provide them with a succinct summary of the presentations, deliberations, and discussions. In preparing the summary, we have striven to capture the key findings (conclusions) and highlight the issues and concerns raised during the plenary and breakout sessions. The presentation of the summary of the proceedings follows the final workshop agenda, which is given in Section I; each section is tabbed to facilitate access to specific workshop topics. The material presented relies heavily on the outline summaries prepared and presented by the Plenary Session Chairman and the Facilitators for each breakout group. These summaries are included essentially as presented. In addition, individuals were assigned to take notes during each session; these notes were used to reconstruct critical issues that were discussed in more detail. The key comments made by the participants, which tended to represent the range of views expressed relative to the issues, are presented immediately following the facilitator's summary outline in order to convey the flavor of the discussions. The comments are not attributed to individuals, since in many instances they represent a composite of several similar views expressed during the discussion. The facilitators were asked to review the writeups describing the outcomes of their sessions for accuracy and content; their suggested changes were incorporated. Every effort has thus been made to reconstruct the views expressed as accurately as possible; however, errors and/or misinterpretations undoubtedly have occurred.

0205 Products and By-Products

Refer also to citation(s) 21159

20772 (IFP–41143) **Synthesis of organometallic of nickel and palladium including bidentate ligands. Application to the catalysis of olefins oligomerization.** Mercier, S. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). Dec 1993. 237p. (In French). Order Number DE94769953. Source: OSTI; NTIS (US Sales Only).

Chelate ligands, containing a hard center (O,N...) and a soft center (P, As...), favor square planar structures. This provides appropriate orbitals to interact with incoming ligands. Such nickel complexes have been synthesized by reaction of β-cetophosphorusylides on bis(cyclooctadiene) nickel, in presence of a phosphine. These compounds are good ethylene oligomerization catalysts, in terms of activity and α-olefin selectivity. NMR spectroscopy and X-ray structures have shown the existence of an intramolecular hydrogen bond involving the enolate oxygen. This

induces less electron density around nickel and favor the production of light α-olefins from ethylene oligomerization.

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 20770

20773 (ANL/CHM/PP–77875) **International petroleum statistics report.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. May 1994. 71p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012636. Source: OSTI; NTIS; GPO; GPO Dep.

This monthly publication provides current international oil data. The Report presents data on international oil production, demand, imports, exports, and stocks. Section 1 contains time series data on world oil production, and on oil demand and stocks in the OECD. Section 2 presents an oil supply/demand balance for the world. Section 3 presents data on oil imports by OECD countries. Section 4 presents annual time series data on world oil production and oil stocks, demand, and trade in OECD countries.

20774 (DOE/EI/22784–T4) **Pennsylvania heating oil and propane price survey, 1993–1994 heating season: Final report.** Fletcher, R.A. Pennsylvania Energy Office, Harrisburg, PA (United States). Bureau of Fossil Fuels. 20 May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-91EI22784. Order Number DE94012335. Source: OSTI; NTIS; GPO Dep.

The State Heating Oil and Propane Price (SHOPP) survey for the 1993–1994 heating season was conducted by the Pennsylvania Energy Office (PEO) in conjunction with the US Department of Energy, Energy Information Administration (DOE/EIA). The objective of the program was to collect price information for residential No. 2 heating oil and propane. Prices were to be collected on the first and third Mondays of each month, starting on October 4, 1993, and extending through March 21, 1994. When the survey started on October 4, 1993, the average No. 2 charge price for residential customers was 85.0 cents per gallon. On January 31, the DOE requested that the survey be conducted on a weekly basis. An extended period of extremely cold weather had increased demand for petroleum products. The seasonal high of 94.7 cents was reached on February 14, 1994. The price average declined to 91.8 cents on March 21, at the conclusion of the survey. This was an increase of 8.0 percent for the season. The results of the October 4, 1993, price survey indicated an average unweighted price of 108.9 cents per gallon for a residential customer. The average price rose to 116.2 cents on March 21, for a seasonal increase of 6.7 percent.

20775 (DOE/EIA–0109(94/05)) **Petroleum supply monthly, May 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 27 May 1994. 148p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012771. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of four publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other publications are the Weekly Petroleum Status Report (WPSR), the Winter Fuels Report, and the Petroleum supply annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of columbia). The reporting universe includes those petroleum sectors in primary supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections: Summary Statistics and Detailed Statistics.

20776 (DOE/EIA–0340(93)/1) **Petroleum supply annual 1993: Volume 1.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. Jun 1994. 197p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013720. Source: OSTI; NTIS; GPO Dep.

The Petroleum Supply Annual (PSA) contains information on the supply and disposition of crude oil and petroleum products. The publication reflects data that were collected from the petroleum industry during 1993 through annual and monthly surveys. The PSA is divided into two volumes. This first volume contains four sections: Summary Statistics, Detailed Statistics, Refinery Capacity, and Oxygenate Capacity each with final annual data. The second volume contains final statistics for each month of 1993, and replaces data previously published in the Petroleum Supply Monthly (PSM). The tables in Volumes 1 and 2 are similarly numbered to facilitate comparison between them. Below is a description of each section in Volume 1 of the PSA.

20777 (DOE/EIA–0340(93)/2) **Petroleum supply annual 1993: Volume 2.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. Jun 1994. 598p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013718. Source: OSTI; NTIS; GPO Dep.

This publication contains information on the supply and disposition of crude oil and petroleum products. The publication reflects data that were collected from the petroleum industry during 1993 through annual and monthly surveys. This second volume contains final statistics for each month of 1993.

20778 (DOE/EIA–0380(94/05)) **Petroleum marketing monthly, May 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 26 May 1994. 182p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013205. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Marketing Monthly (PMM) provides information and statistical data on a variety of crude oils and refined petroleum products. The publication presents statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, petroleum product sales data include motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane. The Petroleum Marketing Division, Office of Oil and Gas, Energy Information Administration ensures the accuracy, quality, and confidentiality of the published data in the Petroleum Marketing Monthly.

20779 (IFP–41118) **Structures, performances and strategies of international oil companies.** Perruchet, D. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France). Jun 1993. 526p. (In French). Order Number DE94769954. Source: OSTI; NTIS (US Sales Only).

International oil companies are among most important actors of petroleum markets. Industrial firms of big size, the oil companies operate in number of activities and through many countries. Across important changes and more and more uncertainty, the oil companies adapt themselves by transforming their strategies. Main structures of international oil companies are described, by an analysis of firm's size, geographic diversity, vertical integration, diversification of activities and internal organization. Moreover, links between structures and performances are studied. Industrial and commercial performances show that technological superiority is fundamental. Besides, strong economical and financial performances go with dynamic management. Finally, a typology of 56 main international oil companies is built. The evolution from 1980 to 1990 show transformation of competitive positions. However, strategies employed appear relatively stable, given risk minimization goals and research of flexibility. Therefore, competitive analysis is more and more appealing.

0208 Waste Management

20780 (DOE/MT/92007–7) **Characterization of oil and gas waste disposal practices and assessment of treatment costs: Technical progress report, January 1, 1994–March 31, 1994.** Bedient, P.B. Rice Univ., Houston, TX (United States). Dept. of Environmental Sciences and Engineering. 25 Apr 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92007. Order Number DE94013926. Source: OSTI; NTIS; GPO Dep.

This report covers work completed during the sixth quarter for the project. The project consists of three tasks: the first relates to developing a database of waste volumes and disposal methods used by the industry; the second and third tasks are aimed at investigating technologies that could be used for the treatment of produced waters and developing cost estimates for those technologies. The remainder of this report describes progress related to the three tasks in the project. Overall, construction of the Production Environmental Database (PED) is ongoing. While much of the data has been collected and entered into the database, a few data categories are still missing, for example, soils and geology and geohydrology. Work is currently under way to collect these data. In addition, a detailed data analysis has begun in order to develop relationships between oil and gas activities and environmental characteristics. In terms of the treatment of produced water, much of the work in the past quarter was focused on analyzing the costs associated with the treatment and disposal of waste residuals such as sludges.

20781 (DOE/MT/92008–6) **Development of a cost effective environment compliance technology for stripper brine wells: [Annual] report, January 1, 1993–December 31, 1993.** Adewumi, M.A.; Watson, R.W.; Tian, S.; Heckman, S.; Safargar, S.; Drielinger, I. Pennsylvania State Univ., University Park, PA (United States). Dept. of Petroleum and Natural Gas. 8 Mar 1994. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92008. Order Number DE94013918. Source: OSTI; NTIS; GPO Dep.

The specific objective of the research is to demonstrate that the characteristics of wastewater from stripper oil wells and marginal gas wells are sufficiently similar to be treated under a standardized treatment methodology, that the environmental impacts of the discharge of treated brines from both stripper oil and marginal gas wells can be adequately regulated, and that the inclusion of marginal gas wells in the same category as stripper oil wells is appropriate, especially for wells operating in the Appalachian Basin. The work accomplished during 1992 for both the field-scale and the laboratory-scale treatment facilities focused on iron removal from the field and synthetic brines. The laboratory work also included single-element kinetics studies to determine the effect of one metal on another with respect to the rates of the various reactions. The laboratory process studies investigated such parameters as the sand bed thickness, the temperature of the system, the angle of the aeration unit, and the presence of the retention tank. All of these laboratory parametric studies provided insight into how each component of the treatment process contributes to the removal of iron from the synthetic brine. Similar studies have begun for investigating copper removal effectiveness. As for the field work, several brines from sandstone formations in Pennsylvania, such as the Red Valley brine and the Warren brine, were treated with the field unit. The results of our analyses indicated that the field unit effectively removes iron from these field brines.

0209 Environmental Aspects

Refer also to citation(s) 21070, 21773, 22488, 22599, 22616

20782 (DOE/ER/12101–T1) **Photoassisted oxidation of oil films on water: Final performance report, January 1, 1990–March 31, 1993.** Heller, A. Texas Univ., Austin, TX (United States). Dept. of Chemical Engineering. 19 Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER12101. Order Number DE94012334. Source: OSTI; NTIS; GPO Dep.

The objective of the project has been the development of a technology for cleaning up oil spills on water through their photocatalytic oxidation. The photocatalyst used was titanium dioxide. Nanocrytalline TiO_2, of anatase or anatase/rutile phase, was bound to hollow ceramic microspheres of sufficiently low density to be buoyant on water. In the presence of these, under sunlight, oil films were photocatalytically oxidized by dissolved oxygen.

20783 (DOE/MC/30098–3756) **Effect of ethanol denaturant on gasoline RVP (revised): Topical report, June 21, 1993–December 31, 1993.** Wu, L.; Timpe, R.C. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Dec 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-93MC30098. Order Number DE94013213. Source: OSTI; NTIS; GPO Dep.

The Clean Air Act (CAA) Amendments of 1990 require further reduction in gasoline Reid vapor pressure (RVP) to reduce pollution. This research focused on characterizing the effect of ethanol denaturant and water on the RVP of the final ethanol-blended fuel. Anectdotal stories tell of up to a 0.5-psi effect of ethanol denaturant on the RVP of the finished ethanol-blended gasoline. Additionally, earlier Energy & Environmental Research Center (EERC) data indicated water could have a significant effect on the RVP. It was necessary to scientifically verify these effects using acceptable laboratory protocols.

0220 Transport, Handling, and Storage

Refer also to citation(s) 20787

0230 Properties and Composition

20784 (ANL/ER/PP–77882) **Theoretical CI study of the vertical electronic spectrum of ethane.** Chantranupong, L. (Wuppertal Univ. (Germany). Theoretische Chemie); Hirsch, G.; Buenker, R.J.; Dillon, M.A. Argonne National Lab., IL (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States);Deutsche Forschungsgemeinschaft, Bonn (Germany). DOE Contract W-31109-ENG-38. Order Number DE94013311. Source: OSTI; NTIS; GPO Dep.

Ab initio multireference single- and double-excitation configuration interaction (MRD-CI) calculations are reported for the ground and 32 excited electronic states of ethane, as well as its two lowest ionic states, ^2E_g and $^2A_{1g}$. The transition energy results indicate that the $3a_{1g}$ molecular orbital is 0.3–0.6 eV more stable than the $1e_g$ LUMO for the ethane D_{3d} equilibrium conformation. The strongest transition is computed to occur for the $3a_{1g} \rightarrow 3p\sigma$ $^1A_{2u}$–$^1A_{1g}$ excitation at 9.933 eV, with an optical f value of 0.1152. The n = 4 Rydberg transitions are also calculated and are found to occur with roughly 40% of their n = 3 counterparts. The observed broadness of the ethane UV spectrum is believed to be caused primarily by the high density of Rydberg upper states, as well as significant relaxation effects which occur upon excitation from the ethane electronic ground state.

20785 (IFP–41151) **Catalysis in non aqueous ionic medium. Metathesis of olefins by tungsten complexes.** Di Marco-van-Tiggelen, F. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). Jan 1994. 272p. (In French). Order Number DE94769951. Source: OSTI; NTIS (US Sales Only).

Room-temperature molten salts have been studied as electrolytes for batteries or as solvents for electrochemical reactions (example: metal coating). They can also be used as solvents for transition metal catalytic cationic complexes (examples: nickel complexes for olefin dimerization, Ziegler-Natta titanium complexes for ethylene polymerization). They are particularly interesting because of their non-miscibility with non functionalized olefins and in consequence they can be used in two-phase catalysis. For this purpose, the properties expected from these media as well as their compositions are different from those expected for electrochemistry. We have studied mixtures of dialkylimidazolium chloride with ethylaluminium chloride compounds like $Et_xAlCl_{(3-x)}$ (with x = 0, 1,

2 or 3). The catalytic reaction we were interested in is the olefin metathesis by tungsten complexes.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 20740

20786 (DOE/MC/28087–3792) **Integrated seismic study of naturally fractured tight gas reservoirs: Technical progress report, January 1, 1994–March 31, 1994.** Mavko, G.; Nur, A. Stanford Univ., CA (United States). Dept. of Geophysics. 29 Apr 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC28087. Order Number DE94013388. Source: OSTI; NTIS; GPO Dep.

The study area is located at the southern end of the Powder River Basin in Converse County in east-central Wyoming. It is a low permeability fractured site, with both gas and oil present. Reservoirs are highly compartmentalized due to the low permeabilities, and fractures provide the only practical drainage paths for production. The two formations of interest are: The Niobrara, a fractured shale and limey shale to chalk, which is a reservoir rock, but also its own source rock; and the Frontier, a tight sandstone lying directly below the Niobrara, brought into contact with it by an unconformity. This was the tenth quarter of the contract. During this quarter the investigators (1) continued processing the seismic data, and (2) continued modeling some of the P-wave amplitude anomalies that we see in the data

0303 Drilling, Production, and Processing

Refer also to citation(s) 20749, 20750, 20766, 20767

0304 Products and By-Products

Refer also to citation(s) 20675, 21159, 22085

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 20773

20787 (DOE/EIA–0130(94/05)) **Natural gas monthly, May 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 25 May 1994. 104p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013198. Source: OSTI; NTIS; GPO; GPO Dep.

The Natural Gas Monthly (NGM) highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information. The featured articles for this month are: Opportunities with fuel cells, and revisions to monthly natural gas data.

0307 Waste Management

Refer also to citation(s) 20779, 20780

0320 Transport, Handling, and Storage

20788 (FRNC-TH–3734) **Protection of storage pressure vessels in the flames; the watering by running and the fireproofing.** Guillemet, R. Ecole Nationale Superieure des Mines, 75 - Paris (France); Ecole Nationale Superieure des Mines, 42 - Saint-Etienne (France). Nov 1992. 171p. (In French). Order Number DE94769949. Source: OSTI; NTIS (US Sales Only).

The bursting of petroleum pressure vessel in case of fire on the storage site may produce the boiling liquid expanding vapor explosion extremely damaging for the environment. The research is to find safety means to have enough time to get under control. There are two methods of safety: the fireproofing of the outer walls of storage with a solid material, the watering of the outer walls. For this last method the great question is the following: what is the optimal water flow on the outer wall of a storage vessel surrounded with the flames of a fire in order to maintain the system in good conditions. We have chosen to study the behaviour of a water film streaming homogeneously on a wall. For this work there are 3 studies: the hydrodynamics of the flowing, the protective character of this screen, the modification of thermic transfers brought by watering on a plane wall, then on a storage with non plane geometry. refs., figs., tabs.

0340 Combustion

Refer also to citation(s) 21287

20789 (NEI-DK–1510) **Comparison/verification of advanced numerical tools for flow calculations.** Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Braendsler og forbraendingsteknik, Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Braendsler og forbraendingsteknik. Rasmussen, N.B.K.; Nedergaard Myken, A. Dansk Gasteknisk Center A/S, Hoersholm (Denmark). Dec 1993. 186p. Contract ENS-1323/89-18. Order Number DE94771125. Source: OSTI; NTIS.

EFP-89.

Two codes for Computational Fluid Dynamics were tested, a finite volume code, KAMELEON-II, needing an orthogonal grid with straight lines and a finite element code, TUFCA, permitting non-orthogonal body-fitted but structured grid. The basic 1-dimensional (1-D) equation of scalar problems, of laminar flow problems, of turbulent flow problems and finally of combustion problems including thermal radiation were among tested cases. Different interpolation schemes are used in the two codes, and the differences in the solutions of the basic 1-D equation are presented. For solution of flow problems different solution algorithms are used such as SIMPLE, SIMPLEC, SIMPLERC, etc. Solutions of laminar flow cases are presented and the two codes show only small deviations. For turbulent flows, KAMELEON-II uses the standard κ-ϵ model of turbulence while TUFCA uses an improved K-E model which is presented. An improved wall law model is used by TUFCA. Results of several test cases in turbulent flows are presented in addition to differences in solutions and comparison with empirical data. In combustion modelling, the novel EDK model including both chemical kinetics and turbulent mixing is introduced. Only reduced models are implemented. An improved simplified model of thermal radiation from gases is introduced. The model also covers radiation of particles and soot, but only for optically thin cases. The EDK model of combustion as well as the simplified model of thermal gas radiation have been implemented in both codes. Results of a few test cases including combustion and thermal radiation are presented. The importance of good pre- and post-processing facilities such as those of KAMELEON-II are emphasized. (AB) (52 refs.)

20790 (NEI-DK–1528) **Ice formation on balanced outlet.** Teknisk note, 2/1993, Teknisk note, 2/1993. Pedersen, P. Dansk Gasteknisk Center A/S, Hoersholm (Denmark). Nov 1993. 34p. (In Danish). Order Number DE94771106. Source: OSTI; NTIS.

It is described under which conditions there would be a risk of ice formation and a following blockage of a vertical balanced outlet in a domestic gas-fuelled boiler. Such a blockage would cause the boiler to stop operating as the control element that reacts to lack of air for combustion would cut off the supply of gas. Measurements were taken of the temperature levels in examples from Danish authorized vertical balanced outlets connected to two types of boilers in relation to an outdoor temperature of -20 degrees centigrade and a wind velocity of 8 m/s. It is pointed out that if the boiler is correctly dimensioned in relation to the household's heating needs and the outlet does not exceed 5 meters in length there will be no risk of ice formation. (AB)

20791 (NEI-DK–1534) **Round robin test of an atmospheric gas boiler: Synthesis of the results.** Schweitzer, J. Dansk

Gasteknisk Center A/S, Hoersholm (Denmark). Dec 1992. 19p. Order Number DE94771108. Source: OSTI; NTIS.

The method (practical organization and calculations) used for this Round Robin Test is the ISO 5725: (Precision of test methods - Determination of repeatability and reproducibility by inter-laboratory test). For several measurements, the obtained results show that a solution concerning the measurements must be worked out in order to decrease the dispersion of results between laboratories. This is particularly crucial for CE marking, for directives application (full and part load efficiency), and for CEN standard type testing (CO, NO_x emissions). The causes of bad reproducibility can be classified as follows: The methodology description in the test standard is insufficient. The method of the test standard is not detailed enough in order to achieve a sufficient reproducibility. The applied procedures (test procedures, internal quality assurance: calibration, etc.) are not equivalent or satisfactory. Some significant factors are not taken into account in the results (e.g. humidity influence on NO_x). (au) (10 refs.)

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 20642

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

20792 (CNIC–00718) **The geological characteristics and forming conditions of granite type uranium-rich ore deposits.** Li Tiangang (Beijing Research Inst. of Uranium Geology (China)); Tong Hangshou; Feng Mingyue; Li Yuexiang; Xu Zhan. China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 8p. (In Chinese). (BRIUG–0008.). Order Number DE94625890. Source: OSTI; NTIS (US Sales Only); INIS.

The forming conditions and concentration mechanism of rich ore, criteria of ore prospecting and selection of uranium-rich ore target area are introduced in the article that is based on the studying of geological characteristics and conditions of granite type uranium-rich ore deposits of No 201 and 361 and on the comparisons of rich and poor ore deposits in geological conditions. Some new view points are also presented as the separate deposition of uranium minerals and gangue minerals is the main mechanism to form rich ore, for rich ore formation the ore enrichment by superimposition is not a universal regularity and most uranium-rich ore deposits are formed within one mineralization stage or mainly in one mineralization stage.

20793 (CNIC–00719) **Conditions and potential evaluation of the uranium mineralization in volcanic basins at the west section of the Yanliao mineral belt.** Wang Zhengbang (Beijing Reserach Inst. of Uranium Geology (China)); Zhao Shiqin; Luo Yi; Zhou Dean; Xiao Xiangping. China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 9p. (In Chinese). (BRIUG–0009.). Order Number DE94625891. Source: OSTI; NTIS (US Sales Only); INIS.

The West section of the Yanliao Mineral Belt is an important prospective uranium mineralization area in volcanic basins at North China. It has undergone three evolutionary periods and developed into six large volcanic collapse faulted basins with tri-layer structure. This leads to three times of pre-enrichment and multiple mineralization of uranium. Finally, the accumulation of uranium and superimposed reworked actions of uranium mineralization resulted in the formation of uranium deposits. After analyzing conditions of uranium mineralization, a model for uranium mineralization of mixed hydrothermal solution of multiple sources in penetrating volcanic collapse faulted basins and seven exploring criteria are suggested. On this basis the evaluation of prospect in this area is positive, and the main exploring strategy has been decided. Furthermore, five prospective areas of mineralization and three most favorable mineralization zones are selected. For exploring large size or super-large size uranium deposits in the area, the key is to strengthen the study and boring of deep layers. Thus, the mineralization in the deep layers or basement may be found. The prediction of deep blind deposits in known ore districts has been proved effectively.

20794 (CNIC–00722) **The quantitative calculation of comprehensive uranium-bearing capability in volcanic rock basins and the selection of uranium-bearing basins.** Liu Xiaoyu (Beijing Research Inst. of Uranium Geology (China)). China Nuclear Information Centre, Beijing, BJ (China). Apr 1993. 12p. (In Chinese). (BRIUG–0011.). Order Number DE94625892. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the studies of the origin of continental intermediate-acid volcanic magmas, the original uranium content in the magmas, the evolution of magmas and the late re-model of volcanic rocks, the mechanism of uranium concentration towards hydrothermal fluid and volatile components is suggested. A formula to calculated comprehensive uranium-bearing capability and a quantitative evaluating model of volcanic rock basins are proposed. By using above method, superior uranium-bearing basins can be selected from a large quantity of volcanic rock basins. The verification of correctness for this method has been proved, and the result is in good agreement with the uranium mineralization in the known regions. Two first class prospective basins have been selected from 16 volcanic rock basins in the southeast China. These reduce the number of target area and the results are satisfactory.

20795 (CNIC–00735) **The evolutionary characteristics and study of uranium mineralization conditions of early precambrian basement and old granitoids in Northern Hebei province of China.** Xia Yuliang (Beijing Research Inst. of Uranium Geology (China)); Rong Jiashu; Lin Jinrong; Zheng Maogong; Wen Xiyuan. China Nuclear Information Centre, Beijing, BJ (China). May 1993. 15p. (In Chinese). (BRIUG–0012.). Order Number DE94625893. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the systematic studies of petrology, geochemistry and isotope geochronology, the Early Precambrian metamorphic complex in Northern Hebei province of China can be divided into three different series, i.e. granulite series, khondalite series and amphibolitic-felsic rock series. The so called 'magmatic granitoids' in that area are actually some magmagranites with different ages and different geneses, and they are not formed by migmatization. Up to now, the discovered Huaian complex which was formed in 3.5 Ga ago is the oldest nuclear area in the northern margin of North-China Platform. The granulite series, khondalite series and amphibolitic-felsic rock series belong to Early Archaean (>3.0 +- 0.1 Ga), Middle Archaean (>2.7 +- 0.1 Ga) and Later Archaean (>2.4 +- 0.1 Ga) respectively. The geological time scale of the Early Precambrian for Northern Hebei Province has been built. According to the synthetic analyses of various factors there is no prospect of uranium mineralization in the ancient terrain. However, the Mesozoic volcanic basins covering over the Hercynian Period granites would be main goal for looking for large uranium deposits in north part in that area.

20796 (CNIC–00753) **Investigation of remote sensing geology in the northern Anxi area of Gansu Province: The application of synthetical remote sensing in the 1:50,000 geology survey and the prognosis of gold uranium mineralization in south band of Beishan.** Dai Wenhan (Xianyang Research Inst. of Uranium Geology, Shaanxi (China)). China Nuclear Information Centre, Beijing, BJ (China). Jul 1993. 19p. (In Chinese). (XYRIUG–0005.). Order Number DE94625894. Source: OSTI; NTIS (US Sales Only); INIS.

The study of 1 : 50,000 remote sensing geology survey and prognosis of gold (uranium) mineralization in the area of northern Anxi of Gansu province has been completed. The synthetical remote sensing and multi-source information compounding technologies, such as land-satellites TM and MSS images, airborne color infrared photography and infrared ray scanning digital images, are used in the study. On the basis of information enhancement and extraction of remote-sensing images, using the theory of remote sensing to explore mineral deposits and the field investigations, many achievements have been reached, such as applications of synthetical remote sensing technology, fundamental study of geology, prognosis of gold (uranium) minerals and 1 : 50,000 remote-geologic mapping. 21 mineral resource maps and

geologic maps are obtained. Nearly one thousand of altered rock zones are interpreted and found. 71 new gold anomaly hydrothermal alteration zones and 23 gold mineralized places are discovered (maximum Au 71 x 10^{-6}). 17 minerogeneration prospective areas, 67 gold-ore searching targets and favorable areas of uranium mineralization are identified. It gives important materials for searching new mines.

20797 (INIS-BR–3322) **The hydrothermal alteration in the context of geologic evolution from Pocos de Caldas Alkaline Massif, MG-SP.** Garda, G.M. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1990. 264p. (In Portuguese). Order Number DE94625895. Source: OSTI; NTIS (US Sales Only); INIS.

The Pocos de Caldas Alkaline Massif covers 800 km^2, a quarter of which is hydrothermally altered. Such proportion is uncommon, when compared to the know alkaline massifs of the world. The hydrothermal alteration is associated with Zr, U and Mo mineralizations which are predominantly located in the central-southern portion of the massif, in the central-eastern circular structure. The colour of the altered rock (and its soil) in that area is typically whitish beige to yellowish white and is regionally called potassic rock. The Osamu Utsumi Mine, also referred to as the uranium ore of Campo do Cercado, is located 25 Km to the south of Pocos de Caldas City and was explored, from 1977 to 1989, through the open pit method. A sequence of alteration minerals adapted to lowering temperatures should be expected; however, only illite and alkaline feldspar are observed in the hydrothermally altered portions of the massif, and their formation must have been controlled mainly by kinetic, other than thermal factors. The irrestrict circulation of relatively hotter hydrothermal fluids must have happened at the beginning of the process, diminishing immediately after the cooling of the brecciated areas (and the subjacent magmatic body), leading the system to kinetics levels that made subsequent hydrothermal alteration impossible. (author).

20798 (INIS-BR–3327) **Phurcalite and others secondary uranium minerals from Perus, Sao Paulo, Brazil.** Atencio, D. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1991. 157p. (In Portuguese). Order Number DE94625896. Source: OSTI; NTIS (US Sales Only); INIS.

Phurcalite has been found filling fractures in the tourmaline-bearing granitic pegmatite of Perus, in the north-west part of Sao Paulo city, Brazil. It forms aggregates of radiating euhedral crystals up to 5 mm in length. The crystals are bright yellow, transparent and display vitreous to adamantine lustre. Its streak is pale yellow. Phurcalite is brittle, with a conchoidal fracture, and non-fluorescent. The crystal structure of phurcalite has been solves by single-crystal x-ray diffraction methods and refined to R = 3.8% using 2065 observed [$I > 3\sigma(I)$] reflections. The structure consists of $[(U\ O_2)_3\ O_2\ (P\ O_4)_2\ ^{4n-}]_n$ layers, parallel to (010), connected by Ca^{2+} ions and H_2 O. The coordination polyhedra are: for U(1) hexagonal bi pyramid; for U(2) and U(3) pentagonal bi pyramids; for Ca(4) and Ca(5) capped trigonal prism and triangulated dodecahedron, respectively; and for P(6) and P(7) tetrahedra. As a consequence of this work, the molecular formula of phurcalite previously reported as $Ca_2\ (U\ O_2)_3\ (P\ O_4)_2\ (OH)_4.4\ H_2$ O must be changed to $Ca_2\ (U\ O_2)_3\ O_2\ (P\ O_4)_2.7\ H_2$ O. Other secondary uranium minerals associated with Perus phurcalite are autunite, torbernite, meta-autunite, meta-torbernite, chernikovite, meta-uranocircite I, phosphuranylite, uranophane-alpha, uranophane-beta, haiweeite, barian week site and perhaps also bassetite, meta-tyuyamunite and meta-haiweeite. Opal, tridymite, cristobalite, secondary quartz, saponite and rhodochrosite occur associated to the uranium minerals. (author).

0504 Feed Processing

Refer also to citation(s) 20932, 23259

20799 (CNIC–00723) **Technology for fabrication of ceramic UO_2 powder with fluidized bed.** Wu Guanhe (Material Research Inst. of Nuclear Power Inst. of China, Chengdu, SC (China)); Li Tao. China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 10p. (In Chinese). (SINRE–0037.). Order Number DE94625563. Source: OSTI; NTIS (US Sales Only); INIS.

Using AUC process with fluidized bed to fabricate natural ceramic UO_2 powder with nuclear purity is introduced. The effects of technological parameters of decomposition, reduction of AUC process and stabilization of UO_2 powder on the performance of final UO_2 product have been studied, and the optimum technological parameters are obtained. The qualified natural ceramic UO_2 powder with nuclear purity can be prepared by this technology and existing equipment.

0505 Uranium Enrichment

Refer also to citation(s) 20799, 20805

0507 Fuels Production and Properties

Refer also to citation(s) 20910, 20920, 20988, 21082, 21113, 21353, 21490, 21569, 21587, 21951, 22167, 22493, 23292, 23293

20800 (BNWL–556) **Pacific Northwest Laboratory monthly activities report, August 1967.** Paul, R.S. Pacific Northwest Lab., Richland, WA (United States). Sep 1967. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013681. Source: OSTI; NTIS; GPO Dep.

Declassified.

This monthly activity report summarizes work done by the staff of Battelle-Northwest in support of the Division of Production and assistance programs directed by the Hanford Plant. The report is divided into four sections: direct AEC sponsored programs; assistance to Douglas United Nuclear; assistance to Isochem; and technical assistance to the Hanford Plant. The work is wide ranging, from environmental monitoring and remediation, to process development, fuel fabrication and studies, metallurgy, corrosion, cracking, etc.

20801 (DPW–55-159-Del.Ver.) **Atomic Energy Division plant capacity manual Savannah River Plant and Dana Plant.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Atomic Energy Div. May 1960. 93p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–733). Order Number DE94012623. Source: OSTI; NTIS; GPO Dep.

This report is a summary of plant service capacities at the Savannah River Plant and the Dana Plant. The report is divided into different areas of the plants, and includes information on services such as process steam, clarified water, deionized water, electric distribution systems, electric generating capacity, filtered water, process water, river water, well water, etc.

20802 (DPW–55-294) **Forecast of uranium metal requirements for development, covering July, August, and September 1955.** Fisher, R.E. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 27 Jun 1955. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–729). Order Number DE94012125. Source: OSTI; NTIS; GPO Dep.

This memorandum provides an estimate of the uranium requirements for the third and fourth quarters of calendar year 1955.

20803 (HW–31350) **Chemical development unit progress report, March 1954.** Woodfield, F.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 31 Mar 1954. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007364. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Chemical Development Unit during the month of March 1954.

20804 (HW–31718) **Hot semi-works Fiberglas filters for ventilation air and off-gas.** Hanford Works, Richland, WA (United States). 5 Oct 1950. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94009747. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. OFF-GAS SYSTEMS/filters; FILTERS/specifications; FILTERS; SPECIFICATIONS; FIBERGLASS; LAYERS; PERFORMANCE TESTING; SEPARATION EQUIPMENT; HANFORD RESERVATION

20805 (HW–55571-Del.) **Chemical Processing Department monthly report for March 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Apr 1958. 94p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94008162. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Chemical Processing Department during the month of March 1958.

20806 (HW–61312) **Specifications for Critical Mass Control Redox Plant - E-metal.** Harmon, M.K. Pacific Northwest Lab., Richland, WA (United States). 1 Jul 1959. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013508. Source: OSTI; NTIS; GPO Dep.

The specifications given in this document cover the processing of E-Metal. E-Metal is defined as natural uranium which has been enriched with U-235 to a concentration of 0.95 percent. The higher U-235 content makes the E-Metal more reactive than either natural or irradiated natural uranium. This difference in reactivity places a definite limit on the amount of massive metal that can be charged to the present Redox dissolvers. Once the slugs have been dissolved, the processing of E-Metal is essentially the same as the processing of natural uranium. Thus, except for the dissolver charge size, the following specifications reflect few actual changes in numerical limits. One change that needs to be recognized is that the amount of U-235 plus plutonium in the metal solution is much closer to the maximum "always safe" ratio than with irradiated natural uranium. Once the E-Metal uranium has been separated from its accompanying plutonium, no critical mass of uranium can be assembled because the enrichment is below the minimum critical.

20807 (HW–62656) **Fuels Development Operation: Quarterly progress report, July, August, September, 1959.** Pacific Northwest Lab., Richland, WA (United States). 15 Oct 1959. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013676. Source: OSTI; NTIS; GPO Dep.

The present quarterly report is the continuation of a series issued by the new Fuels Development Operation. Reports in this series combine portions of the quarterly reports by the former Metallurgy Research and Fuel Technology Sub-Sections. Work reported includes research conducted by the Physical Metallurgy Operation, and research and development conducted by Fuel Design, Fuels Fabrication Development and Ceramic Fuels Development Operations.

20808 (HW–62952-RD) **Continuity of Operations Program: Prime Separations and Uranium Conversion Facilities.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Dec 1959. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010853. Source: OSTI; NTIS; GPO Dep.

Declassified.

This Program detailed in this report is related to the Product Development, Palmolive, and Non-Production Fuels Programs under New and Special Products and Processes Category where the prime separations plants supply raw materials or processing support of these other programs. Likewise, Increased Plant Return Program items affecting the Purex, Redox, and UO_3 Plants must be integrated with the Continuity of Operations Program. Since the primary separations plants feed the 234-5 Facility, the 234-5 Program is also related to Continutiy of Operation.

20809 (HW–64941) **Basis for design scope: Plutonium Reclamation Facility, Z Plant, Project CAC-880.** Braden, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Apr 1960. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010530. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report discuss the design of the Plutonium Reclamation Facility the capacity of which will be 300 kilograms per month or 3600 kilograms per year or plutonium. The subject facility, as the name implies, must be extremely flexible in its ability to handle a wide variety of feed materials. The new facility will be operating on a three-shift day, five-day week, 40-week year with an overall efficiency of 75 percent; twelve weeks per year will be required for "turnaround" time to enable campaign operation for segregation of feed plutonium by isotopic content.

20810 (HW–66297) **Strontium-90: Recovery and lag storage interim program.** Beard, S.J.; Swift, W.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Aug 1960. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011061. Source: OSTI; NTIS; GPO Dep.

Declassified.

Increased interest in the civilian, space, and military applications of isotopic power has prompted a study by which the Chemical Processing Department can provide the interim strontium-90 requirements on a schedule considerably accelerated from that previously proposed. This document summarizes a study of the technical and operational feasibility and hazards involved in: recovery of semi-refined megacurie quantities of Sr^{90} from current Purex waste; lag storage of the Sr^{90} fraction in the 244 CR Process Vault for Sr^{89} decay; and subsequent reconcentration and refinement to a bulk product suitable for isolation and packaging by Hanford Laboratories.

20811 (HW–66346-Suppl.1) **Redox Birch recovery scope design: Revision 1.** Hanthorn, H.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Oct 1960. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007363. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The scope design for Birch recovery at Redox was presented in September 12, 1960. Final plutonium purification and decontamination by anion exchange in a pulsed-bed contactor under development by Hanford Laboratories was proposed. Potential advantages of low cost and improved operability were anticipated from the new contactor; when these were not demonstrated in the development work in time to meet project schedules, it was decided to revert to the Higgins-type contactor for which considerable Purex operating experience can be drawn upon for design bases. This scope revision presents the necessary changes to cover the change of contactors.

20812 (HW–67904) **Fuels Development Operation quarterly progress report, April–June 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1960. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012013. Source: OSTI; NTIS; GPO Dep.

Declassified.

The following are reported: Physical metallurgy (Th, Th-U, U, Zr base alloys); metallic fuels development; and ceramic fuels development (UO_2).

20813 (HW–68448C) **Production test IP-310-A-FP, determination of the dimensional stability of uranium fuel cores classified by the fuel core tester (UT-2).** Clinton, M.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Apr 1961. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012089. Source: OSTI; NTIS; GPO Dep.

Declassified.

Since it is now possible to obtain a heat-treated U core that is randomly oriented and has a finer average grain size, it is necessary to irradiate measured, transformed fuel cores over the full range of grain sizes, in order to compare relative dimensional stabilities. An improved ultrasonic tester, Fuel Core Tester-UT-2, is used to test all fuel cores.

20814 (HW–73238) **Ingot-dingot comparison.** Bloomstrand, R.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 May 1962. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013677. Source: OSTI; NTIS; GPO Dep.

Declassified.

For approximately the past two years, alloyed dingot uranium has been irradiated on a production scale for evaluation of rupture performance relative to ingot uranium. Supplementary data on dimensional behavior and certain pre-irradiation measurements have been accumulated under the Quality Certification Program. This report presents a comparison of ingot and dingot performance based on data obtained to date from this testing program. The discussion consists of three sections: (I) dimensional stability, (II) external bond quality, and (III) reactor rupture performance.

20815 (HW–74718) **Plutonium Metallurgy Operation quarterly progress report, July–September 1962.** Wick, O.J.; Nelson, T.C.; Stewart, R.W.; Thomas, I.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1962. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012032. Source: OSTI; NTIS; GPO Dep.

Declassified.

Progress reports are presented for the following tasks: physical and mechanical metallurgy; plutonium fuels development; and special fabrication of plutonium and other radioactive materials.

20816 (HW–76227-ADD.) **February 1963 production studies addendum.** Lang, L.W.; McCurry, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Feb 1964. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010495. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides an addendum to the February 1963 production studies and details Neptunium 237 production yields.

20817 (HW–79331-RD) **U-233.** Smith, A.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Oct 1963. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010609. Source: OSTI; NTIS; GPO Dep.

Declassified.

This memorandum discusses the problems associated with the production and use of Uranium 233 for an early test shot.

20818 (HW–80847) **Progress report on NASA cermet studies identification SNC-12, January 1964.** Cadwell, J.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Feb 1964. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010985. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details progress in an intensive investigation which was launched to determine the basic mechanisms leading to gross loss of UO_2 fuel upon thermal cycling of UO_2-W cermets and to suggest means of overcoming this serious operational problem. (This problem was recently uncovered at both Lewis Research Center and at Hanford). More than 40 separate experiments were conducted in four high temperature furnaces, at temperatures to 2600 C, pressures from 10^{-5} mm vacuum to 1000 psi, atmospheres including wet, pure and tank H_2-Ar mixtures, N_2, and He, and cycle periods from 30 seconds to 15 hours. Specimens examined included two types of NASA-fabricated plates, three types of Hanford high energy impacted discs, and several other materials used for single experiment evaluation.

20819 (HW–81662) **Analysis of alternatives: Plutonium button-line improvements.** Johnson, B.M.; Smith, V.W.; Swain, E.O.; Szulinski, M.J.; Zahn, L.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 May 1964. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012422. Source: OSTI; NTIS; GPO Dep.

Declassified.

Reduction of Pu nitrate solution to metal is accomplished in the button line portion of the Remote Mechanical Line. Several areas of deficiency exist in the facility, which must be corrected in order to maintain continuity. In December 1963, a study was undertaken to define and evaluate the operational and economic parameters pertinent to deciding to improve or replace the button line. This paper documents the study and presents the conclusions and recommendations.

20820 (JAERI-M–94-034) **Data book of the isotopic composition of spent fuel in light water reactors.** Naito, Yoshitaka (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kurosawa, Masayoshi; Kaneko, Toshiyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 231p. Order Number DE94770634. Source: OSTI; NTIS; INIS.

In the framework of the activity of the working group on Evaluation of Nuclide Generation and Depletion in the Japanese Nuclear Data Committee, we summarized the assay data of the isotopic composition of LWR spent fuels in order to verify the accuracy of the burnup calculation codes. The report contains the data collected from the 13 light water reactors (LWRs) including the 9 LWRs (5 PWRs and 4 BWRs) in Europe and USA, the 4 LWRs (2 PWRs and 2 BWRs) in Japan. The collected data were sorted into the irradiation history of the fuel samples, the composition of the fuel assemblies, the sampling position and the isotopic composition of the fuel samples. (author).

0508 Spent Fuels Reprocessing

Refer also to citation(s) 20919, 20921, 20922, 21085, 21329, 21331, 21383, 21536, 21952, 22046, 22104, 22139, 22140

20821 (BNWL-CC–315) **Transfer measurement statistics derived from Purex Processing Measurements' Quality Control Program.** Hough, C.G. Pacific Northwest Lab., Richland, WA (United States). 23 Nov 1965. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012865. Source: OSTI; NTIS; GPO Dep.

Declassified.

The Purex Processing Measurements Quality Control Program was designed to provide for orderly accumulation of measurements data suitable for statistical evaluation and to identify those elements of a measurement which, if improved, would result in significant reduction in overall measurement variation. This report gives an analysis of the audit data obtained at four transfer stations: L9 plutonium product loadout, K6 uranium product to storage, F15 salt waste to F16 and D5 dissolved feed to process. Estimates of variation caused by analytical, sampling and volume or weight instrumentation were computed and combined to give variation associated with a single batch transfer. Procedures for collection of future data that are more suitable for statistical evaluation are suggested. Methods used to compute random and fixed variation estimates are discussed.

20822 (BNWL-CC–592) **Transfer measurement statistic derived from Purex processing measurements' quality control program, second half of 1965.** Hough, C.G. Pacific Northwest Lab., Richland, WA (United States). 31 Mar 1966. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012862. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report gives an analysis of the audit data obtained during the last half of 1965 at eight transfer stations: L9 plutonium product, K6 uranium product, F15 salt waste, D5 dissolved feed, F18 utility waste, G8 organic wash waste, R8 organic wash waste, and U3 laboratory waste. Two ways of improving the Purex quality control program are described.

20823 (CNIC–00670) **Study on reprocessing of uranium-thorium fuel with solvent extraction for HTGR.** Jiao Rongzhou (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); He Peijun; Liu Bingren; Zhu Yongjun. China Nuclear Information Centre, Beijing, BJ (China). Aug 1992. 8p. (In Chinese). (TSHUNE–0050.). Order Number DE94625565. Source: OSTI; NTIS (US Sales Only); INIS.

A single cycle process by solvent extraction with acid feed solution is suggested. The purpose is to reprocess uranium-thorium fuel elements which are of high burn-up and rich of ^{232}U from HTGR (high temperature gas cooled reactor). The extraction cascade tests have been completed. The recovery of uranium and

thorium is greater than 99.6%. By this method, the requirement, under remote control to re-fabricate fuel elements, of decontamination factors for Cs, Sr, Zr-Nb and Ru has been reached.

20824 (CNIC–00741) **Continuous combustion of moving-bed for unirradiated spherical fuel-element of HTGR.** Hu Xien (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Wang Xuejun; Dai Weizhi; Zhu Yongjun. China Nuclear Information Centre, Beijing, BJ (China). Apr 1993. 11p. (In Chinese). (TSHUNE–0064.). Order Number DE94625566. Source: OSTI; NTIS (US Sales Only); INIS.

The single fuel-element combustion and continuous combustion of a full-size moving-bed with the capacity of 100 fuel-elements/day were studied for head-end process of reprocessing. The single fuel-element combustion experiment shows that the combustion is controlled by reaction kinetics and mass transfer. The dimensionless items for a given conversion can be expressed by the sum of dimensionless items of reaction and mass transfer. The a apparent reaction rate constant can be obtained by linear regression. The experimental results also show that the moving-bed operation is better than batch operation in lower hold-up, more stable thermal power and easier control. The axial temperature distribution in moving-bed was estimated with pseudo-homogeneous one-dimensional model, and the heat transfer coefficient between bed and wall in the model is close to that from De Wasch-Froment equation.

20825 (CNIC–00748) **Experimental research of the process of solvent extraction of Pu with 3A mixer-settler.** Jiao Rongzhou (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Wang Jianchen; Liu Bingren; Wang Sulan. China Nuclear Information Centre, Beijing, BJ (China). Jun 1993. 9p. (In Chinese). (TSHUNE–0067.). Order Number DE94625567. Source: OSTI; NTIS (US Sales Only); INIS.

The process of third plutonium cycle with critically safe multi-stage mixer-settler is experimentally studied. During the experiment the total level surface of two phases is lower than the critically safe limit. The uranium (plutonium) is extracted through ($1 \approx 9$) stages then separated from fission products in ($10 \approx 17$) stages of the mixer-settler. The experimental values of U(Pu), HNO_3 profiles in extraction cascade are also obtained. The recovery ratio of U(Pu) is greater than 99.9%, and stage efficiency of extraction section of the mixer-settler is 95%.

20826 (HW–7-1764) **Separations process batch size.** Mackey, B.H. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 9 Jun 1945. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011060. Source: OSTI; NTIS; GPO Dep.

Declassified.

A maximum batch size of 400 g Pu-239 is favored. The upper safe limit of product batch size is over 1 kg.

20827 (HW–56933) **Process Specifications for Operational Control: Purex Plant: Revision 1.** Irish, E.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Nov 1958. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012041. Source: OSTI; NTIS; GPO Dep.

Declassified.

The Process Specifications for Operational Control of the Purex Plant(l) have been revised to define the operational control changes as a result of (a) converting the Purex Plant from three to two cycles, and (b) the use of the Plutonium Anion Exchange Unit (N-Cell) for routine plutonium concentration in place of the L-Cell Concentration Package. The flowsheets specified in Figures I-1, -2, and -3, and Table I fulfill the requirements for nuclear and chemical safety within the process as defined in Purex Process Specifications. The flowsheet also provides adequate recovery and decontamination to meet the product purity requirements itemized in Section 3.04. To clarify the two-cycle flowsheet and to simplify its use, the specifications are listed on graphic flow diagrams with the notation that process control allows a deviation of plus or minus five percent on all specifications except TBP concentration in solvent.

20828 (HW–58749) **Chemical Processing Department Control Study: Final report on the control of CPD product materials.** Shepard, D.F.; Hough, C.G.; Burke, R.C.; Stewart, K.B. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Jan 1959. 79p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010852. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to present the conclusions and recommendations obtained during the course of the CPD Control Study and the conceptual framework upon which they are based. Primary emphasis has been given to the control of product materials. In order to logically present the background for the definition and delineation of an appropriate CPD Control System, Section III of this report discusses a control system in the following manner; (1) the description of the control system information requirements, (2) the definition of the conceptual framework of product material control, (3) the discussion of the interrelationships of production scheduling, process control and accountability and (4) the methods for the effective utilization of control system information. Section IV utilizes this conceptual framework in order to enable a logical presentation of a proposed product material control system for the CPD. A summary of conclusions and recommendations is included in Section II. The Appendices consist of discussions of specific analysis conducted during the study. Other related reports that have been issued during the course of the study are included in the references.

20829 (HW–70743) **Establishment of code word "MGR".** Jaynes, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Aug 1961. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010603. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report documents the code name MGR, which refers to the recycle of the U-236 precursor of Birch (Np-237). It is recommended that a number designation, such as MGR-1H, MGR-2H, etc., for Hanford and MGR-1S, MGR-2S, etc., for Savannah River be used where appropriate to indicate the number of times a particular batch of material has gone through a cycle.

20830 (HW–72549) **Cesium-137 index for nuclear materials content of coating waste.** Schneider, R.A.; Zimmer, W.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Feb 1962. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010573. Source: OSTI; NTIS; GPO Dep.

Declassified.

Cs-137 has been chosen as a possible index of the plutonium and uranium in coating waste. This index is a stable ratio as long as the plutonium formation rate (Pu/MD) is stable. Calculations are presented for Purex and Redox. It is recommended that the Cs-137 index method be used for determining nuclear materials content in coating waste at both Purex and Redox; this will result in higher but more accurate statements of Pu, U losses in coating waste.

20831 (HW–72745) **Analysis of three batches of PB (pinch bottle)-1 material, December 1962.** Ringle, R.P.; Steinhauser, J.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Feb 1962. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010648. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. FUEL RODS/dissolution; DISSOLUTION; REDOX PROCESS; DISSOLVERS; SAMPLING; QUANTITATIVE CHEMICAL ANALYSIS

20832 (HW–80202) **Redox weekly process reports, January–December 1964.** Isaacson, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Jan 1964. 217p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010501. Source: OSTI; NTIS; GPO Dep.

Declassified.

Data compilation.

20833 (HW–83455-A) **Purex Operation - material balance and net production report, July 1964 - Fiscal Year 1965.** Burge, W.L. Pacific Northwest Lab., Richland, WA (United States). 12 Aug 1964. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013539. Source: OSTI; NTIS; GPO Dep.

This report is an inventory record of materials which were received and shipped from the Purex Process during this time period. Material accounting includes uranium, uranium-235, plutonium, and other transuranics.

20834 (INIS-mf–14219) **Simultaneous precipitation of carbonato complexes of uranium and plutonium with cationic surfactants: Final report.** Heckmann, K.; Strnad, J.; Huber, K. Regensburg Univ. (Germany). Inst. fuer Physikalische und Makromolekulare Chemie. 7 Dec 1992. 24p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 02W6089. Order Number DE94774015. Source: OSTI; NTIS (US Sales Only); INIS.

The proposed method allows to separate Uranium, Thorium and Cerium from carbonate solutions and the further processing of these metals to mixed oxides. The separation can be divided into three steps: 1. Precipitation of the metals with a 10-fold surplus of carbonate and a 5-fold surplus of a cationic surfactant. 2. Thermal decomposition of the precipitates in air at 600 C. 3. Reduction of U(VI) to U(IV) with CO at 500 C. Mixed oxides in any ratio are formed in this way. This is possible due to the coprecipitation of both metals. Comparing the standard potentials it is clear that Ce(IV) is more easily reduced that Pu(IV). Therefore, the chance on the formation of U/Pu mixed oxides by this method is quite good. (orig.)

20835 (RFP–4805) **Analytical methods for determining the reactivity of pyrochemical salts.** Phillips, A.G.; Stakebake, J.L. EG and G Rocky Flats, Inc., Golden, CO (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-940815–4: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94010767. Source: OSTI; NTIS; GPO Dep.

Pyrochemical processes used for the purification of plutonium have generated quantities of residue that contain varying amounts of reactive metals such as potassium, sodium, calcium, and magnesium. These residues are currently considered hazardous and are being managed under RCRA because of the reactivity characteristic. This designation is based solely on process knowledge. Currently there is no approved procedure for determining the reactivity of a solid with water. A method is being developed to rapidly evaluate the reactivity of pyrochemical salts with water by measuring the rate of hydrogen generation. The method was initially tested with a magnesium containing pyrochemical salt. A detection limit of approximately 0.004 g of magnesium was established. A surrogate molten salt extraction residue was also tested. Extrapolation of test data resulted in a hydrogen generation rate of 4.4 mg/(g min).

20836 (WHC-EP–0737) **The chemistry of tributyl phosphate at elevated temperatures in the Plutonium Finishing Plant Process Vessels.** Barney, G.S.; Cooper, T.D. Westinghouse Hanford Co., Richland, WA (United States). [1994]. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012399. Source: OSTI; NTIS; INIS; GPO Dep.

Potentially violent chemical reactions of the tributyl phosphate solvent used by the Plutonium Finishing Plant at the Hanford Site were investigated. There is a small probability that a significant quantity of this solvent could be accidental transferred to heated process vessels and react there with nitric acid or plutonium nitrate also present in the solvent extraction process. The results of laboratory studies of the reactions show that exothermic oxidation of tributyl phosphate by either nitric acid or actinide nitrates is slow at temperatures expected in the heated vessels. Less than four percent of the tributyl phosphate will be oxidized in these vented vessels at temperatures between 125°C and 250°C because the oxidant will be lost from the vessels by vaporization or decomposition before the tributyl phosphate can be extensively oxidized. The net amounts of heat generated by oxidation with concentrated nitric acid and with thorium nitrate (a stand-in for plutonium nitrate) were determined to be about -150 and -220 joules per gram of tributyl phosphate initially present, respectively. This is not enough heat to cause violent reactions in the vessels. Pyrolysis of the tributyl phosphate occurred in these mixtures at temperatures of 110°C to 270°C and produced mainly 1-butene gas, water, and pyrophosphoric acid. Butene gas generation is slow at expected process vessel temperatures, but the rate is faster at higher temperatures. At 252°C the rate of butene gas generated was 0.33 g butene/min/g of tributyl phosphate present. The measured heat absorbed by the pyrolysis reaction was 228 J/g of tributyl phosphate initially present (or 14.5 kcal/mole of tributyl phosphate). Release of flammable butene gas into process areas where it could ignite appears to be the most serious safety consideration for the Plutonium Finishing Plant.

0509 Transport, Handling, and Storage

Refer also to citation(s) 20876, 21073, 21330, 21358, 21589, 22163, 22186, 22208, 22684

20837 (CONF-940553–59) **Highway and interline transportation routing models.** Joy, D.S.; Johnson, P.E. Oak Ridge National Lab., TN (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 22-26 May 1994. Order Number DE94012318. Source: OSTI; NTIS; INIS; GPO Dep.

The potential impacts associated with the transportation of hazardous materials are important issues to shippers, carriers, and the general public. Since transportation routes are a central characteristic in most of these issues, the prediction of likely routes is the first step toward the resolution of these issues. In addition, US Department of Transportation requirements (HM-164) mandate specific routes for shipments of highway controlled quantities of radioactive materials. In response to these needs, two routing models have been developed at Oak Ridge National Laboratory under the sponsorship of the U.S. Department of Energy (DOE). These models have been designated by DOE's Office of Environmental Restoration and Waste Management, Transportation Management Division (DOE/EM) as the official DOE routing models. Both models, HIGHWAY and INTERLINE, are described.

20838 (DOE/RW/00286–4) **Midwestern High-Level Radioactive Waste Transportation Project: Final performance report, February 7, 1989–December 31, 1993.** Council of State Governments, Lombard, IL (United States). Midwestern Office. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-94RW00286 ; FC01-89CH10402. Order Number DE94013004. Source: OSTI; NTIS; INIS; GPO Dep.

On February 17,1989, the Midwestern Office of The Council of State Governments and the US Department of Energy entered into a cooperative agreement authorizing the initiation of the Midwestern High-Level Radioactive Waste Transportation Project. The transportation project continued to receive funding from DOE through amendments to the original cooperative agreement, with December 31, 1993, marking the end of the initial 5-year period. This progress report reflects the work completed by the Midwestern Office from February 17,1989, through December 31,1993. In accordance with the scopes of work governing the period covered by this report, the Midwestern Office of The Council of State Governments has worked closely with the Midwestern High-Level Radioactive Waste Committee. Project staff have facilitated all eight of the committee's meetings and have represented the committee at meetings of DOE's Transportation Coordination Group (TCG) and Transportation External Coordination Working Group (TEC/WG). Staff have also prepared and submitted comments on DOE activities on behalf of the committee. In addition to working with the committee, project staff have prepared and distributed 20 reports, including some revised reports (see Attachment 1). Staff have also developed a library of reference materials for the benefit of committee members, state officials, and other interested parties. To publicize the library, and to make it more accessible to potential

users, project staff have prepared and distributed regular notices of resource availability.

20839 (DOE/WIPP–93-058) **Comparative study of Waste Isolation Pilot Plant (WIPP) transportation alternatives.** USDOE Albuquerque Operations Office, NM (United States). Waste Isolation Pilot Plant Project Office. Feb 1994. 234p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE94012083. Source: OSTI; NTIS; INIS; GPO Dep.

WIPP transportation studies in the Final Supplement Environmental Impact Statement for WIPP are the baseline for this report. In an attempt to present the most current analysis, this study incorporates the most relevant data available. The following three transportation options are evaluated for the Disposal Phase, which is assumed to be 20 years: Truck shipments, consisting of a tractor and trailer, with three TRUPACT-IIs or one RH-72B; Regular commercial train shipments consisting of up to three railcars carrying up to 18 TRUPACT-IIs or up to six RH-72Bs; Dedicated train shipments consisting of a locomotive, an idle car, railcars carrying 18 TRUPACT-IIs or six RH-72Bs, another idle car, and a caboose or passenger car with an emergency response specialist. No other cargo is carried. This report includes: A consideration of occupational and public risks and exposures, and other environmental impacts; A consideration of emergency response capabilities; and An extimation of comparative costs.

20840 (HW–79424) **Fabrication process test: FPT-63-28, Reduction of in-process inventory.** Fisher, J.G.; Lewis, L.I.; Pinkerton, J.M. Pacific Northwest Lab., Richland, WA (United States). 30 Oct 1963. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010498. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the process of casting plutonium for the purpose of reducing the in-process inventory. The plutonium is cast, then rough machined to produce a storable form, then stored for the ten-day waiting period.

20841 (INIS-JP–018, pp. 1083-1088) **Recent developments in the area of insurance and indemnity coverage for transportation of radioactive materials in the United States of America.** Brown, O.F. II (Davis Wright Tremaine, Washington, DC (United States)). 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The 1988 statutory amendments retained the basic structure of the Price-Anderson insurance-indemnity system. A number of significant changes were advocated during the lengthy Congressional review process. but they were rejected. Thus, Price-Anderson remains an exemplary system for providing liability coverage for the risks of a potentially-hazardous nuclear activities. (J.P.N.).

20842 (ORNL/FTR–4936) **Travel to Austria to participate in the IAEA's Standing Advisory Group on the Safe Transport of Radioactive Materials in order to advise the IAEA on its transportation safety program: Foreign trip report, March 17–26, 1994.** Rawl, R.R. Oak Ridge National Lab., TN (United States). 11 Apr 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94009929. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in the tenth meeting of SAGSTRAM, the IAEA's senior advisory group on transportation safety matters. SAGSTRAM provides advice to the IAEA Director General concerning the direction and content of the IAEA's transportation program. Several areas were discussed that have been identified as major issues related to the ongoing revision of the IAEA "Regulations for the Safe Transport of Radioactive Materials," Safety Series (SS) No. 6. Activities were initiated that will result in a complete revision of SS No. 6 by 1996, and each major issue was reviewed to ensure that it will be adequately addressed during the revision process. Other aspects of the IAEA transportation program, such as information collection and coordinated research programs, were also reviewed, and advice was provided on the future directions for these projects.

20843 (SAND–93-0111) **Determination of influence factors and accident rates for the Armored Tractor/Safe Secure Trailer.** Phillips, J.S. (Sandia National Labs., Albuquerque, NM (United States)); Clauss, D.B.; Blower, D.F. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94010661. Source: OSTI; NTIS; GPO Dep.

Operating environments, such as road type, road location, and time of day, play an important role in the observed accident rates of heavy trucks used in general commerce. These same factors influence the accident rate of the Armored Tractor/Safe Secure Trailer (AT/SST) used by the Department of Energy to transport hazardous cargos within the continental United States. This report discusses the development of accident rate influence factors. These factors, based on heavy trucks used in general commerce, are used to modify the observed overall AT/SST accident rate to account for the different operating environments.

20844 (SAND–94-0697C) **The RADTRAN 4 computational system for transportation risk assessment: A prototype for the information superhighway.** Neuhauser, K.S. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940212–4: Seminar on developments in radioactive waste transport, Vienna (Austria), 21-25 Feb 1994). Order Number DE94013344. Source: OSTI; NTIS; INIS; GPO Dep.

The RADTRAN 4 computer code for transportation risk assessment is the central code in a system that contains both other codes and data libraries. Some of these codes and data libraries supply input data for RADTRAN; others perform supplemental calculations. RADTRAN 4 will be released by the IAEA in an international version known as INTERTRAN 2 in 1995. In the United States, RADTRAN 4 and its supporting system may be accessed via the INTERNET, a precursor to the Information Superhighway. Similar networks are being contemplated elsewhere in the world, and the RADTRAN System may serve as a prototype for systems on these networks. A system is desirable for the following reasons. Some classes of data and data-handling methods are country-specific and some are not – ancillary codes and data libraries that provide the latter are not affected by national and regional borders while the former must be provided on a country-by-country basis. Making the invariant portions available to all users in an international system would simplify quality assurance (QA) and, therefore, the reliability and consistency of risk results. Among the classes of data used in RADTRAN 4 (and INTERTRAN 2) and the supplemental calculational capabilities that are essentially invariant for all countries and regions are: (1) radionuclide characteristics such as half-life, photon energy, and dose-conversion factors; (2) characteristics of radioactive-material packages found in international commerce; (3) features of highly standardized international transportation modes (primarily sea and air); and (4) uncertainty analysis. These features and their related QA benefits are discussed.

20845 (SRT-ATS–940032) **Applied technology section: Monthly report, March 1994.** Buckner, M.R. Westinghouse Savannah River Co., Aiken, SC (United States). 20 Apr 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012940. Source: OSTI; NTIS; GPO Dep.

This is a monthly report giving the details on research currently being conducted at the Savannah River Technology Center. The following are areas of the research, engineering modeling and simulation, applied statistics, applied physics,experimental thermal hydraulics,and packaging and transportation.

20846 (WHC-SA–2156) **US Department of Energy Automated Transportation Management System.** Portsmouth, J.H. Westinghouse Hanford Co., Richland, WA (United States). Jan 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940225–115: Waste management '94, Tucson, AZ (United States), 27 Feb - 3

mar 1994). Order Number DE94013582. Source: OSTI; NTIS; INIS; GPO Dep.

The U.S. Department of Energy (DOE) Transportation Management Division (TMD) is responsible for managing its various programs via a diverse combination of Government-Owned/ Contractor-Operated facilities. TMD is seeking to update it automation capabilities in capturing and processing DOE transportation information. TMD's Transportation Information Network (TIN) is an attempt to bring together transportation management, shipment tracking, research activities and software products in various stages of development. The TMD's Automated Transportation Management System (ATMS) proposes to assist the DOE and its contractors in performing their daily transportation management activities and to assist the DOE Environmental Management Division in its waste management responsibilities throughout the DOE complex. The ATMS system will center about the storage, handling and documentation involved in the environmental clean-up of DOE sites. Waste shipments will be moved to approved Treatment, Storage and Disposal (TSD) facilities and/or nuclear material repositories. An additional investment in shipping samples to analytical laboratories also involves packaging and documentation according to all applicable U.S. Department of Transportation (DOT) or International Air Transport Association (IATA) regulations. The most immediate goal of effectively managing DOE transportation management functions during the 1990's is an increase in automation capabilities of the DOE and its contractors. Subject-matter experts from various DOE site locations will be brought together to develop and refine these capabilities through the maximum use of computer applications. A major part of this effort will be the identification of the most economical modes of transportation and enhanced management reporting capabilities for transportation analysis. The ATMS system will also provide for increased strategic and shipment analysis during the 1990's and beyond in support of the DOE environmental mission.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 21028, 21952

20847 (CONF-940386–3) **Cost comparison of laboratory methods and four field screening technologies for uranium-contaminated soil.** Douthat, D.M.; Armstrong, A.Q. Oak Ridge National Lab., TN (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Cost efficient acquisition and utilization of data in the management of hazardous waste sites; Herndon, VA (United States); 23-25 Mar 1994. Order Number DE94012752. Source: OSTI; NTIS; INIS; GPO Dep.

To address the problem of characterizing uranium-contaminated surface soil at federal facilities, the Department of Energy has the development of four uranium field screening technologies, under the direction of the Uranium-in-Soils Integrated Demonstration (USID) Program. These four technologies include: a long-range alpha detector a beta scintillation detector, an in situ gamma detector, and a mobile laser ablation-inductively coupled plasma/atomic emission spectrometry (LA-ICP/AES) laboratory. As part of the performance assessment for these field screening technologies, cost estimates for the development and operation of each technology were created. A cost study was conducted to compare three of the USID field screening technologies to the use of traditional field surveying equipment to adequately characterize surface soils of a one-acre site. The results indicate that the use of traditional equipment costs more than the in situ gamma detector, but less than the beta scintillation detector and LRAD. The use of traditional field surveying equipment results in cost savings of 4% and 34% over the use of the beta scintillation and LRAD technologies, respectively. A study of single-point surface soil sampling and laboratory analysis costs was also conducted. Operational costs of the mobile LA-ICP/AES laboratory were compared with operational costs of traditional sampling and analysis, which consists of collecting soil samples and conducting analysis in a radiochemical laboratory. The cost study indicates that the use of the mobile LA-ICP/AES laboratory results in cost savings of 23% and 40% over traditional field sampling and laboratory analysis conducted by characterization groups at two DOE facilities.

20848 (WHC-SA–2422) **Cooperative fish-rearing programs in Hanford Site excess facilities.** Herborn, D.I.; Anderson, B.N. Westinghouse Hanford Co., Richland, WA (United States). May 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940815–27: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013586. Source: OSTI; NTIS; INIS; GPO Dep.

In, 1993, two successful fish-rearing pilot projects were conducted in Hanford Site 100 K Area water treatment pools (K Pools) that are excess to the US Department of Energy needs. Beginning this spring, two larger cooperative fish programs will be undertaken in the K Pools. One program will involve the Yakama Indian Nation, which will rear, acclimate, and release 500,000 fall chinook salmon. The other program involves the Washington Department of Fish and Wildlife, which will rear warm-water specie (walleye and channel catfish) for planting in state lakes. Renewed economic vitality is the goal expected from these and follow-on fish programs.

20849 (WSRC-MS–94-0335) **Novel procurement concepts utilized to award contract for vitrification of an F006 mixed waste sludge.** Pickett, J.B.; Musall, J.C.; Hayes, A.F.; Campbell, E.E. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–30: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013286. Source: OSTI; NTIS; INIS; GPO Dep.

A number of novel concepts were utilized in a procurement bid process to award a contract for the stabilization of a mixed wastewater treatment plating line sludge from the Reactor Materials department (M-Area) at the Savannah River site (SRS). The contract award was based on a combination of technical and cost considerations. The technical aspects included an evaluation of the technical validity of the proposed process(es) (i.e., would the process work?), the physical resources of the proposer and the expertise of the personnel proposed to work on the program, and prior experience of the firm wit treatment and stabilization of mixed (radioactive and hazardous) wastes. This paper will concentrate on the cost and the bid award considerations, rather than the technical aspects.

0520 Waste Management

Refer also to citation(s) 20799, 20834, 20838, 20844, 20848, 21048, 21058, 21065, 21071, 21073, 21074, 21078, 21079, 21080, 21093, 21095, 21103, 21105, 21107, 21108, 21109, 21110, 21329, 21331, 21589, 21870, 22012, 22046, 22158, 22161, 22201, 22376, 22493, 22549, 22569, 22570, 22582, 22583, 22590, 22602, 22603, 22604, 22605, 22665, 22728, 22751, 23263

20850 (ANL–94/9) **Surveillance of Site A and Plot M - report for 1993.** Golchert, N.W. Argonne National Lab., IL (United States). May 1994. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012403. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the environmental surveillance program conducted at Site A/Plot M in the Palos Forest Preserve area for CY 1993 are presented. The surveillance program is the ongoing remedial action that resulted from the 1976-1978 radiological characterization of the site. That study determined that very low levels of hydrogen-3 (as tritiated water) had migrated from the burial ground and were present in two nearby hand-pumped picnic wells. The current program consists of sample collection and analysis of air, surface and subsurface water, and bottom sediment. The results of the analyses are used to (1) determine the migration pathway of water from the burial ground (Plot M) to the hand-pumped picnic wells, (2) establish if buried radionuclides other than hydrogen-3 have migrated, and (3) generally characterize the radiological environment of the area. Hydrogen-3 in the Red Gate Woods picnic wells was still detected this year, but the average and maximum concentrations were significantly less than found earlier. Tritiated water continues to be detected in a number of wells, boreholes, dolomite holes, and a surface stream. For many years it was the only radionuclide found to have migrated in measurable quantities. Analyses since

1984 have indicated the presence of low levels of strontium-90 in water from a number of boreholes next to Plot M. The available data does not allow a firm conclusion as to whether the presence of this nuclide represents recent migration or movement that may have occurred before Plot M was capped. The results of the surveillance program continue to indicate that the radioactivity remaining at Site A/Plot M does not endanger the health or safety of the public visiting the site, using the picnic area, or living in the vicinity.

20851 (ANL/CMT-ACL/CP–82220) **Analytical procedures for waste minimization and pollution prevention.** Green, D.W.; Smith, L.L.; Crain, J.S.; Boparai, A.S.; Schilling, J.B. Argonne National Lab., IL (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940578–3: Pollution prevention conference, Denver, CO (United States), 3-5 May 1994). Order Number DE94011476. Source: OSTI; NTIS; GPO Dep.

Procedures exist for waste characterization, but waste minimization and pollution prevention have not usually played a role in development of these procedures. The US Department of Energy (DOE) expects to require several million characterizations over a 30-year period to accomplish the Department's goals in environmental restoration and waste management. The waste generated by the analytical procedures used for characterizations is a significant source of new DOE waste. We have begun investigating ways to reduce these secondary wastes, focusing on three areas: microanalysis using flow injection; reduction of solvent volume required for dissolution of waste samples for radiochemical analysis; and alternative samples preparation for analysis of organic constituents in waste samples. Preliminary results are reported.

20852 (ANL/CMT/CP–79802) **Analytical electron microscopy examination of solid reaction products in long-term test of SRL 200 waste glasses.** Buck, E.C.; Fortner, J.A.; Bates, J.K.; Feng, X.; Dietz, N.L.; Bradley, C.R.; Tani, B.S. Argonne National Lab., IL (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-931108–38: Fall meeting of the Materials Research Society (MRS), Boston, MA (United States), 29 Nov - 3 dec 1993). Order Number DE94005482. Source: OSTI; NTIS; INIS; GPO Dep.

Alteration phases, found on the leached surfaces and present as colloids in the leachates of 200-based frit (fully active and simulated) nuclear waste glass, reacted under static test conditions, at a surface area to leachate volume ratio of 20,000 m^{-1} for 15 days to 728 days, have been examined by analytical electron microscopy. The compositions of the secondary phases were determined using x-ray energy dispersive spectroscopy and electron energy loss spectroscopy, and structural analysis was accomplished by electron diffraction. Long-term samples of simulated glass, which had undergone an acceleration of reaction after 182 days, possessed a number of silicate secondary phases, including; smectite (iron silicate and potassium iron alumina-silicate, weeksite (uranium silicate), zeolite (calcium potassium alumino-silicate), tobermorite (calcium silicate), and a pure silica phase. However, uranium silicates and smectite have also been observed in tests, which have not undergone the acceleration of reaction, in both the leachate and leached layer, suggesting that these phases are not responsible for the acceleration of reaction.

20853 (ANL/CMT/CP–80022) **Defining a metal-based waste form for IFR pyroprocessing wastes.** McDeavitt, S.M.; Park, J.Y.; Ackerman, J.P. Argonne National Lab., IL (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940204–6: 123. annual meeting of the Minerals, Metals and Materials Society, San Francisco, CA (United States), 27 Feb - 3 mar 1994). Order Number DE94005389. Source: OSTI; NTIS; INIS; GPO Dep.

Pyrochemical electrorefining to recover actinides from metal nuclear fuel is a key element of the Integral Fast Reactor (IFR) fuel cycle. The process separates the radioactive fission products from the long-lived actinides in a molten LiCl-KCl salt, and it generates a lower waste volume with significantly less long-term toxicity as compared to spent nuclear fuel. The process waste forms include a mineral-based waste form that will contain fission products removed from an electrolyte salt and a metal-based waste form that will contain metallic fission products and the fuel cladding and process materials. Two concepts for the metal-based waste form are being investigated: (1) encapsulating the metal constituents in a Cu-Al alloy and (2) alloying the metal constituents into a uniform stainless steel-based waste form. Results are given from our recent studies of these two concepts.

20854 (ANL/CMT/CP–80123) **The role of natural glasses as analogues in projecting the long-term alteration of high-level nuclear waste glasses: Part 1.** Mazer, J.J. Argonne National Lab., IL (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-931108–58-Pt.1: Fall meeting of the Materials Research Society (MRS), Boston, MA (United States), 29 Nov - 3 dec 1993). Order Number DE94005920. Source: OSTI; NTIS; INIS; GPO Dep.

The common observation of glasses persisting in natural environments for long periods of time (up to tens of millions of years) provides compelling evidence that these materials can be kinetically stable in a variety of subsurface environments. This paper reviews how natural and historical synthesized glasses can be employed as natural analogues for understanding and projecting the long-term alteration of high-level nuclear waste glasses. The corrosion of basaltic glass results in many of the same alteration features found in laboratory testing of the corrosion of high-level radioactive waste glasses. Evidence has also been found indicating similarities in the rate controlling processes, such as the effects of silica concentration on corrosion in groundwater and in laboratory leachates. Naturally altered rhyolitic glasses and tektites provide additional evidence that can be used to constrain estimates of long-term waste glass alteration. When reacted under conditions where water is plentiful, the corrosion for these glasses is dominated by network hydrolysis, while the corrosion is dominated by molecular water diffusion and secondary mineral formation under conditions where water contact is intermittent or where water is relatively scarce. Synthesized glasses that have been naturally altered result in alkali-depleted alteration features that are similar to those found for natural glasses and for nuclear waste glasses. The characteristics of these alteration features appear to be dependent on the alteration conditions which affect the dominant reaction processes during weathering. In all cases, care must be taken to ensure that the information being provided by natural analogues is related to nuclear waste glass corrosion in a clear and meaningful way.

20855 (ANL/CMT/CP–80571) **Glassy slags as novel waste forms for remediating mixed wastes with high metal contents.** Feng, X.; Wronkiewicz, D.J.; Bates, J.K.; Brown, N.R.; Buck, E.C.; Gong, M.; Ebert, W.L. Argonne National Lab., IL (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–72: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94008464. Source: OSTI; NTIS; INIS; GPO Dep.

Argonne National Laboratory (ANL) is developing a glassy slag final waste form for the remediation of low-level radioactive and mixed wastes with high metal contents. This waste form is composed of various crystalline and metal oxide phases embedded in a silicate glass phase. This work indicates that glassy slag shows promise as final waste form because (1) it has similar or better chemical durability than high-level nuclear waste (HLW) glasses, (2) it can incorporate large amounts of metal wastes, (3) it can incorporate waste streams having low contents of flux components (boron and alkalis), (4) it has less stringent processing requirements (e.g., viscosity and electric conductivity) than glass waste forms, (5) its production can require little or no purchased additives, which can result in greater reduction in waste volume and overall treatment costs. By using glassy slag waste forms, minimum additive waste stabilization approach can be applied to a much wider range of waste streams than those amenable only to glass waste forms.

20856 (ANL/CMT/CP–80987) **An evaluation of vitrification technology: Application to mixed waste at Argonne National Laboratory.** Mazer, J.J.; Devgun, J.S.; Beskid, N.J.; No, H.J. Argonne National Lab., IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–64: Waste management '94, Tucson, AZ

(United States), 27 Feb - 3 mar 1994). Order Number DE94008102. Source: OSTI; NTIS; INIS; GPO Dep.

Argonne National Laboratory-East (ANL-E) is evaluating the feasibility of using vitrification to treat mixed wastes. This program is in the process of identifying glass compositions that can be produced from mixed wastes and additives, with an emphasis on maximizing the waste loading in the glass, and the overall waste volume reduction. Preliminary crucible glass studies with surrogate mixed waste streams have produced a glass composition that could be produced in commercially available melters. This same glass composition, spiked with Resource Conservation Recovery Act (RCRA) metals, pass the Toxic Characteristic Leaching Procedure (TCLP) test. Thus, the final waste form is a low-level radioactive waste. Additional crucible melts with actual mixed waste streams are in progress and will define a compositional envelope of acceptable glasses that will eventually be produced during full-scale melter operations. Evaluations of the likely off-gases from vitrification indicate that the primary off-gases produced during vitrification will include compounds of SO_x, NO_x and CO_2. These compounds are routinely treated in the off-gas portion of vitrification systems. The composition of the melter feed can be adjusted to control some of the off-gases produced, if necessary. The economics suggest that annual cost savings resulting from volume reduction and conversion of mixed waste to low-level waste may be substantial.

20857 (ANL/CMT/CP–81046) **Effects of S/V on secondary phase formation on waste glasses.** Feng, X. (Argonne National Lab., IL (United States)); Buck, E.C.; Bates, J.K.; Gong, M.; Dietz, N.L.; Pegg, I.L. Argonne National Lab., IL (United States); Catholic Univ. of America, Washington, DC (United States). Vitreous State Lab. [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ; AC07-81NE44139. (CONF-940416–9: 96. annual meeting of the American Ceramic Society, Indianapolis, IN (United States), 24-28 Apr 1994). Order Number DE94011508. Source: OSTI; NTIS; INIS; GPO Dep.

Simulated West Valley high-level nuclear waste glass, WV205, was leached with and without buffered media in both deuterated and ordinary water at glass surface area to solution volumes (S/N) of 200–6000 m^{-1}. Examination of the glass surface after testing for 14 days indicated that the S/V-induced pH change plays a dominant role in the development of the altered surface layer and the secondary phases formed. The changes due to SN-induced pH determine the rate of surface layer formation, the element distribution in the surface layer, and possibly, the identities of the secondary phases. Changes due to SN-induced elemental concentration also influence glass reaction rate in terms of the layer thickness and the elemental distribution in the surface layers.

20858 (ANL/CMT/CP–82230) **Treatment of mixed radioactive liquid wastes at Argonne National Laboratory.** Vandegrift, G.F. (and others); Chamberlain, D.B.; Conner, C. Argonne National Lab., IL (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–73: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94008458. Source: OSTI; NTIS; INIS; GPO Dep.

Aqueous mixed waste at Argonne National Laboratory (ANL) is traditionally generated in small volumes with a wide variety of compositions. A cooperative effort at ANL between Waste Management (WM) and the Chemical Technology Division (CMT) was established, to develop, install, and implement a robust treatment operation to handle the majority of such wastes. For this treatment, toxic metals in mixed-waste solutions are precipitated in a semiautomated system using $Ca(OH)_2$ and, for some metals, Na_2S additions. This step is followed by filtration to remove the precipitated solids. A filtration skid was built that contains several filter types which can be used, as appropriate, for a variety of suspended solids. When supernatant liquid is separated from the toxic-metal solids by decantation and filtration, it will be a low-level waste (LLW) rather than a mixed waste. After passing a Toxicity Characteristic Leaching Procedure (TCLP) test, the solids may also be treated as LLW.

20859 (ANL/EA/CP–80973) **Hazardous waste database: Waste management policy implications for the US Department of Energy's Environmental Restoration and Waste Management Programmatic Environmental Impact Statement.** Lazaro, M.A. (Argonne National Lab., IL (United States)); Policastro, A.J.; Antonopoulos, A.A.; Hartmann, H.M.; Koebnick, B.; Dovel, M.; Stoll, P.W. Argonne National Lab., IL (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–68: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94008103. Source: OSTI; NTIS; INIS; GPO Dep.

The hazardous waste risk assessment modeling (HaWRAM) database is being developed to analyze the risk from treatment technology operations and potential transportation accidents associated with the hazardous waste management alternatives. These alternatives are being assessed in the Department of Energy's Environmental Restoration and Waste Management Programmatic Environmental Impact Statement (EM PEIS). To support the risk analysis, the current database contains complexwide detailed information on hazardous waste shipments from 45 Department of Energy installations during FY 1992. The database is currently being supplemented with newly acquired data. This enhancement will improve database information on operational hazardous waste generation rates, and the level and type of current on-site treatment at Department of Energy installations.

20860 (ANL/EA/CP–81120) **Tracking mixed waste from environmental restoration through waste management for the Federal Facility Compliance Act.** Isbell, D. (United States Department of Energy, Germantown, MD (United States)); Tolbert-Smith, M.; MacDonell, M.; Peterson, J. Argonne National Lab., IL (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–56: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94007689. Source: OSTI; NTIS; INIS; GPO Dep.

The Federal Facility Compliance Act required the US Department of Energy (DOE) to prepare an inventory report that presents comprehensive information on mixed wastes. Additional documents, such as site treatment plans, were also required of facilities with mixed waste. For a number of reasons, not all DOE mixed waste sites are able to provide detailed characterization and planning data at this time. Thus, an effort is currently under way to develop a reporting format that will permit mixed waste information across the DOE complex to be tracked as it becomes available.

20861 (ANL/EA/CP–82020) **Approach and issues toward development of risk-based release standards for radioactive scrap metal recycle and reuse.** Chen, S.Y.; Nieves, L.A.; Nabelssi, B.K.; LePoire, D.J. Argonne National Lab., IL (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940406–3: International symposium on decontamination and decommissioning, Knoxville, TN (United States), 27-29 Apr 1994). Order Number DE94007652. Source: OSTI; NTIS; INIS; GPO Dep.

The decontamination and decommissioning of nuclear facilities is expected to generate large amounts of slightly radioactive scrap metal (RSM). It is likely that some of these materials will be suitable for recycling and reuse. The amount of scrap steel from DOE facilities, for instance, is estimated to be more than one million tons (Hertzler 1993). However, under current practice and without the establishment of acceptable recycling standards, the RSM would be disposed of primarily as radioactive low-level waste (LLW). In the United States, no specific standards have been developed for the unrestricted release of bulk contaminated materials. Although standards for unrestricted release of radioactive surface contamination (NRC 1974) have existed for about 20 years, the release of materials is not commonly practiced because of the lack of risk-based justifications. Recent guidance from international bodies (IAEA 1988) has established a basis for deriving risk-based release limits for radioactive materials. It is important, therefore, to evaluate the feasibility of recycling and associated issues necessary for the establishment of risk-based release limits for the radioactive metals.

20862 (ANL/EA/CP–82021) **Accident analysis for high-level waste management alternatives in the US Department of Energy Environmental Restoration and Waste Management Programmatic Environmental Impact Statement.** Folga, S.;

Mueller, C.; Roglans-Ribas, J. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940225–39: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94006813. Source: OSTI; NTIS; INIS; GPO Dep.

A comparative generic accident analysis was performed for the programmatic alternatives for high-level waste (HLW) management in the US Department of Energy Environmental Restoration and Waste Management Programmatic Environmental Impact Statement (EM PEIS). The key facilities and operations of the five major HLW management phases were considered: current storage, retrieval, pretreatment, treatment, and interim canister storage. A spectrum of accidents covering the risk-dominant accidents was analyzed. Preliminary results are presented for HLW management at the Hanford site. A comparison of these results with those previously advanced shows fair agreement.

20863 (ANL/EWM/CP–80446) **Development of a Clean Air Act Title V permit application for Argonne National Laboratory.** Barrett, G.L. Argonne National Lab., IL (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–15: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012461. Source: OSTI; NTIS; GPO Dep.

The Clean Air Act Amendments (CAAA) of 1990 instituted major changes in the way that air emission sources are regulated and permitted. Along with being a major research and development laboratory owned by the US Department of Energy, Argonne National Laboratory (ANL) is also classified as a major source of oxides of nitrogen (NO_x) in the Chicago metropolitan area which has been designated by the US Environmental Protection Agency (USEPA) as severe (17) for ozone. As a major source ANL is therefore required under Title V of CAAA to apply for a federally enforceable permit for all sources of air emissions at the facility. While the ANL Boiler House represents the most significant emission source at the Laboratory, there are, nevertheless, a large number of other emission sources, some of which are currently permitted by the State of Illinois and others of which are exempt from state permitting requirements. A large number of R & D related sources are of relatively small magnitude. The ability to identify, inventory, characterize and classify all sources under the various titles of CAAA constitutes a major challenge for R & D laboratories of this size.

20864 (ANL/RE/CP–82143) **Free vibration analysis of partially filled liquid storage tanks.** Tang, Yu; Chang, Y.W. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–20: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012456. Source: OSTI; NTIS; INIS; GPO Dep.

A study on the free vibration analysis of partially filled liquid storage tanks is presented. The tanks considered are the upright circular cylindrical tanks that are rigidly supported at the base. the top of the tanks are either free or constrained. Two types of constraints are considered, namely, hinged and roller support. The governing differential equations for the tank-liquid system are obtained by application of the Rayleigh-Ritz procedure in combination with Lagrange's equation. The response functions examined include the frequency of the fundamental mode of vibration of the tank-liquid system and the associated modal pressure.

20865 (ANL/RE/CP–82146) **SSI effects for a tank containing two liquids.** Tang, Yu. Argonne National Lab., IL (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–12: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012457. Source: OSTI; NTIS; INIS; GPO Dep.

Following a brief review of a mechanical model which permits consideration of the flexibility of the tank wall and the supporting medium, the effects of the soil-structure interaction on the dynamic response of a laterally excited tank that contains two liquids are examined. The quantities examined include the hydrodynamic pressure, base shear and moments. The results are compared with those obtained with no soil-structure interaction. Only the impulsive component of response is examined; the convective component is for all practical purposes unaffected by soil-structure interaction. It is shown that for the conditions considered, soil-structure interaction reduces the peak response of the tank-liquid system.

20866 (ANL/RE/CP–82360) **Sloshing roof impact tests of a rectangular tank.** Minowa, C. (National Research Inst., for Earth Science and Disaster Prevention, Tusukuba, Ibaraki (Japan)); Ogawa, N.; Harada, I.; Ma, D.C. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–13: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012462. Source: OSTI; NTIS; INIS; GPO Dep.

Some tanks have been damaged at the roofs due to sloshing impact caused by strong earthquakes. It is, therefore, necessary to consider the impact force in the aseismic design code for tank roofs. However, there are few studies on the earthquake responses of storage and process tank roofs. As a first step to investigate the effects of sloshing impact a series of the shaking table tests of a rectangular tank have been conducted at the National Research Institute for Earth Science and Disaster Prevention (NIED). The results of these shaking table tests are presented in the paper. The test tank is rectangular in shape having dimensions of 5 m x 3 m x 2 m length x width x height). The tank was constructed of glass-fiber reinforced plastic panels. Every panel had a flange on four edges, and each panel was connected by bolts along the flange. The test tank was set on the NIED shaking table (15 m by 15 m). Two types of liquid were used, water and a viscous liquid (water mixed with polymeric powders). The roof impact pressures and other quantities were measured. During the tests using the 400 pi El-Centro excitation, the roof deformation sensor steel beam was damaged. The response of side walls with different rigidity were measured in the wall bulging tests. The measured vibrations within the panel plates were larger than those in the panel flanges. The viscous liquid of 100 cp had little influence on wall bulging responses. However, the viscous effects on sloshing responses were observed in the sloshing tests. Approximate analyses of rectangular tanks, considering the influence of static water pressure, are also presented in this paper.

20867 (BNL–52420) **Dynamic response of rigid tanks with inhomogeneous liquids.** Shivakumar, P.; Veletsos, A.; Bandyopadhyay, K. Brookhaven National Lab., Upton, NY (United States). Apr 1994. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94012619. Source: OSTI; NTIS; GPO Dep.

A study of the free vibrational characteristics and of the response to horizontal ground shaking of a rigid cylindrical tank containing an inviscid liquid with a continuous vertical variation in density is presented. The response quantities examined include the vertical sloshing motions of the liquid at its free-surface, and the impulsive and convective components of the hydrodynamic wall pressures and associated tank forces. The equations of motion for the system are formulated for an arbitrary variation in liquid density but the solutions presented are for a density that increases exponentially from top to bottom. Comprehensive numerical data are included which elucidate the underlying response mechanisms and the effects and relative importance of the various parameters involved. The solution for the continuous density variation considered herein is also compared with a previously reported solution in which the liquid was modeled as a multi-layered, discrete system.

20868 (CNIC–00761) **Study on the technical feasibility of disposal of long-lived radioactive wastes by neutron burning in fusion-fission hybrid reactors.** Wu Yican (Academia Sinica, Hefei, AH (China). Inst. of Plasma Physics); Qiu Lijian. China Nuclear Information Centre, Beijing, BJ (China). Jul 1993. 11p. (ASIPP–0037.). Order Number DE94626512. Source: OSTI; NTIS (US Sales Only); INIS.

Two types of conceptual design of fusion-fission hybrid reactor are presented, which is for transmutation of actinide nuclides with nitride fuel or metallic alloy fuel blanket and transmutation of fission products, especially ^{90}Sr, with Pu fuel blanket, respectively. Neutronics and thermal hydraulics calculation were performed to

estimate the performance of the whole system. It was found that the plasma core with recently experimental parameters of plasma physics or the ones to be reached in the near future may drive the blanket which can transmute 17% of the loaded fission product ^{90}Sr or 23% of the loaded actinides after one year operation at neutron wall loading of 1 MW/m^2 and 80% load factor. thus, the present system may burn ^{90}Sr waste from about 40 PWRs of 3 GW(t) or the actinide waste from about 65 PWRs of 3 GW(t), respectively.

20869 (CONF-931136–3) **Biosurfactants and increased bioavailability of sorbed organic contaminants: Measurements using a biosensor.** Strong-Gunderson, J.M. (Oak Ridge National Lab., TN (United States)); Palumbo, A.V.; Applegate, B.; Saylor, G.S. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States); Tennessee Univ., Knoxville, TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400 ; FG05-91ER61193. F4962092-J-0147. From 6. conference on gas, oil and environmental biotechnology; Colorado Springs, CO (United States); 29 Nov - 1 dec 1993. Order Number DE94009161. Source: OSTI; NTIS; INIS; GPO Dep.

Bioremediation of sites contaminated with hydrophobic materials that sorb onto the soil matrix is very difficult due to reduced microbial (bio)availability. Following biosurfactant addition, we have measured an increase in contaminant bioavailability by using a lux biosensor. Direct microbial bioavailability was determined by using a genetically engineered microbial bioreporter strain of Pseudomonas putida. This strain was engineered so the lux genes, which code for light production, are transcriptionally fused with genes that code for contaminant degradation and are thus induced in the presence of specific compounds. By using a bioreporter we can quantify the actual microbial bioavailability of the contaminants and compare it to concentrations measured by other analytical methods (e.g. gas chromatograph). It is possible that these values are not equal to each other. Thus, bioremediation rates may not be accurately predicted if bioavailability is not considered.

20870 (CONF-940159–1) **Adsorption and desorption of contaminants.** Palumbo, A.V. (Oak Ridge National Lab., TN (United States)); Strong-Gunderson, J.M.; DeFlaun, M.; Ensley, B. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Joint 40/50 industry outreach meeting; Seattle, WA (United States); 25-27 Jan 1994. Order Number DE94006549. Source: OSTI; NTIS; INIS; GPO Dep.

The microbial remediation of sites Contaminated with organics is well documented, however, there are some significant problems that remain to be solved in the areas of contaminants sorbed to soils and non-aqueous phase liquid (NAPL) contamination. Methods of in situ bioremediation techniques employ either the stimulation of indigenous populations by nutrient addition, or the addition of prepared bacterial cultures to the subsurface environment. Problems of contaminant sorption and NAPL's are related in that both encompass reduced contaminant bioavailability. Non-aqueous phase liquids have been identified as a priority area for research in the In situ Program due to their presence at DOE sites and the lack of adequate technology to effectively treat this contamination. Bioremediation technologies developed as a result of this project are easily transferred to industry.

20871 (CONF-940212–3) **Inventory and characteristics of current and projected low-level radioactive materials and waste in the United States.** Bisaria, A. (Oak Ridge National Lab., TN (United States)); Bugos, R.G.; Pope, R.B.; Salmon, R.; Storch, S.N.; Lester, P.B. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Seminar on developments in radioactive waste transport; Vienna (Austria); 21-25 Feb 1994. Order Number DE94012331. Source: OSTI; NTIS; INIS; GPO Dep.

The Integrated Data Base (IDB), under US Department of Energy (DOE) funding and guidance, provides an annual update of compiled data on current and projected inventories and characteristics of DOE and commercially owned radioactive wastes. The data base addresses also the inventories of DOE and commercial spent fuel. These data are derived from reliable information from government sources, open literature, technical reports, and direct contacts. The radioactive materials considered are spent nuclear fuel, high-level waste (HLW), transuranic (TRU) waste, low-level waste (LLW), commercial uranium mill tailings, environmental restoration wastes, and mixed-LLW. This paper primarily focuses on LLW inventory and characterization.

20872 (CONF-940225–40) **TRU partnership: Overview of technical challenges and initiatives.** Moore, J.W. (Oak Ridge National Lab., TN (United States)); Martin, M.R.; Mullin, R.J.; Ball, D.E.; Stewart, D.E. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94007412. Source: OSTI; NTIS; GPO Dep.

The Waste Isolation Pilot Plant (WIPP) has been constructed in a geologic salt deposit in Carlsbad, New Mexico. Current plans have the WIPP scheduled to begin permanent emplacement of TRU waste starting in approximately 2000 after completion of a 5-7 year test phase that is scheduled to begin in 1994. The WIPP has prepared a waste acceptance criteria (WAC) that establishes requirements that must be met by waste packages intended for disposal at WIPP. In addition there are other existing criteria (e.g. DOE General Design Criteria 6430.IA), regulations, procedures, guidelines and safety concerns (e.g. ALARA), regarding designing, building and operating radiological waste handling/processing facilities. All of these, along with the desire to minimize each projects total cost, encourage and in some cases dictate the use of new, developing technologies and other innovative technologies and operating philosophies. In the summer of 1990 the TRU Partnership was formed comprising several of the DOE TRU waste generator and storage/disposal sites. This partnership meets approximately quarterly to present the status of each site's projects and has resulted in the establishment of a list of technical/development needs/challenges and initiatives. The initiatives are discussed in this report.

20873 (CONF-940225–111) **Development and demonstration of treatment technologies for the processing of US Department of Energy mixed waste.** Berry, J.B. (Oak Ridge National Lab., TN (United States)); Bloom, G.A.; Kuchynka, D.J. Oak Ridge National Lab., TN (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94012332. Source: OSTI; NTIS; INIS; GPO Dep.

Mixed waste is defined as waste contaminated with chemically hazardous (governed by the Resource Conservation and Recovery Act) and radioactive species [governed by US Department of Energy (DOE) orders]. The Mixed Waste Integrated Program (MWIP) is responding to the need for DOE mixed waste treatment technologies that meet these dual regulatory requirements. MWIP is developing emerging and innovative treatment technologies to determine process feasibility. Technology demonstrations will be used to determine whether processes are superior to existing technologies in reducing risk, minimizing life-cycle cost, and improving process performance. The Program also provides a forum for stakeholder and customer involvement in the technology development process. MWIP is composed of six technical areas that support a mixed-waste treatment system: (1) systems analysis, (2) materials handling, (3) chemical/physical separation, (4) waste destruction and stabilization, (5) off-gas treatment, and (6) final waste form stabilization. The status of the technical initiatives and the current research, development, and demonstration in each of these areas is described in this paper.

20874 (CONF-940499–11) **Mixed Waste Integrated Program emerging technology development.** Berry, J.B. (Oak Ridge National Lab., TN (United States)); Hart, P.W. Oak Ridge National Lab., TN (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Federal environmental restoration and waste minimization conference and exhibition; New Orleans, LA (United States); 25-29 Apr 1994. Order Number DE94012657. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) is responsible for the management and treatment of its mixed low-level wastes (MLLW). MLLW are regulated under both the Resource Conservation and Recovery Act and various DOE orders. Over the next 5 years, DOE will manage over 1.2 m^3 of MLLW and mixed transuranic (MTRU) wastes. In order to successfully manage and treat these mixed wastes, DOE must adapt and develop characterization, treatment, and disposal technologies which will meet performance criteria, regulatory approvals, and public acceptance. Although technology to treat MLLW is not currently available without modification, DOE is committed to developing such treatment technologies and demonstrating them at the field scale by FY 1997. The Office of Research and Development's Mixed Waste Integrated Program (MWIP) within the DOE Office of Environmental Management (EM), OfFice of Technology Development, is responsible for the development and demonstration of such technologies for MLLW and MTRU wastes. MWIP advocates and sponsors expedited technology development and demonstrations for the treatment of MLLW.

20875 (CONF-9404160–1) **Assessing mixed waste treatment technologies.** Berry, J.B. (Oak Ridge National Lab., TN (United States)); Bloom, G.A.; Hart, P.W. Oak Ridge National Lab., TN (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Executive enterprises conference; Charleston, SC (United States); 25-26 Apr 1994. Order Number DE94012658. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) is responsible for the management and treatment of its mixed low-level wastes (MLLW). As discussed earlier in this conference MLLW are regulated under both the Resource Conservation and Recovery Act and various DOE orders. During the next 5 years, DOE will manage over 1,200,000 m^3 of MLLW and mixed transuranic (MTRU) waste at 50 sites in 22 states (see Table 1). The difference between MLLW and MTRU waste is in the concentration of elements that have a higher atomic weight than uranium. Nearly all of this waste will be located at 13 sites. More than 1400 individual mixed waste streams exist with different chemical and physical matrices containing a wide range of both hazardous and radioactive contaminants. Their containment and packaging vary widely (e.g., drums, bins, boxes, and buried waste). This heterogeneity in both packaging and waste stream constituents makes characterization difficult, which results in costly sampling and analytical procedures and increased risk to workers.

20876 (CONF-940553–55) **Long-term effects of neutron absorber and fuel matrix corrosion on criticality.** Culbreth, W.G.; Zielinski, P.R. Nevada Univ., Las Vegas, NV (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 22-26 May 1994. Order Number DE94012155. Source: OSTI; NTIS; INIS; GPO Dep.

Proposed waste package designs will require the addition of neutron absorbing material to prevent the possibility of a sustained chain reaction occurring in the fuel in the event of water intrusion. Due to the low corrosion rates of the fuel matrix and the Zircaloy cladding, there is a possibility that the neutron absorbing material will corrode and leak from the waste container long before the subsequent release of fuel matrix material. An analysis of the release of fuel matrix and neutron absorber material based on a probabilistic model was conducted and the results were used to prepare input to KENO-V, an neutron criticality code. The results demonstrate that, in the presence of water, the computed values of k_{eff} exceeded the maximum of 0.95 for an extended period of time.

20877 (CONF-940553–60) **Structural performance of a Multipurpose Canister shell for HLNW under normal handling conditions.** Ladkany, S.G.; Rajagopalan, R. Nevada Univ., Las Vegas, NV (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 22-26 May 1994. Order Number DE94012150. Source: OSTI; NTIS; INIS; GPO Dep.

A Multipurpose Canister (MPC) is analyzed for critical stresses that occur during normal handling conditions and accidental scenarios. Linear and Non-linear Finite Element Analysis is performed and the stresses at various critical locations in the MPC and its weldments are studied extensively. Progressive failure analysis of the MPC's groove and fillet welds, is presented. The structural response of the MPC to dynamic lifting loads, to loads resulting from an accidental slippage of a crane cable carrying the MPC, and from the impact between two canisters, is evaluated. Nonlinear structural analysis is used in the evaluation of the local buckling and the ultimate failure phenomena in the shell when the steel is in the strain hardening state during impact. Results make a case for increasing the thickness of the shell and all the welds.

20878 (CONF-940815–1) **Environmental Restoration and Waste Management Technology Development projects supporting tank waste processing and disposal.** McGinnis, C.P. (Oak Ridge National Lab., TN (United States)); Hunt, R.D.; Cruse, J.M. Oak Ridge National Lab., TN (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International nuclear and hazardous waste management conference; Atlanta, GA (United States); 14-18 Aug 1994. Order Number DE94009172. Source: OSTI; NTIS; INIS; GPO Dep.

Production of nuclear materials has been a major mission of the US Department of Energy (DOE) and predecessor agencies for the last 50 years. The production processes such as PUREX, REDOX, and bismuth phosphate separations have generated 1×10^8gal of radioactive waste. The waste is currently stored in more than 300 underground storage tanks (USTs) at Hanford, Savannah River, Oak Ridge, and Idaho. The waste in a typical UST is partitioned into three aqueous phases: saltcake, supernate, and sludge. Approximately half of the waste inventory is composed of sodium nitrate and nitrites. The radioactivity of the waste, 1×10^{11} Bq/L is primarily due to ^{137}Cs and ^{90}Sr. Major inorganic species result from aluminum nitrate and concentrated nitric acid that was used for metallic dissolution and from ferrocyanide that was used for cesium removal. Organic chemicals that were used in large amounts during plutonium production and subsequent waste stabilization are concerns from safety and processing standpoints. Prior to storage at Hanford, Savannah River, and Oak Ridge, the pH of the waste was adjusted to 10–14 with the addition of NaOH. DOE has made a commitment to retrieve the waste from the USTs that are not in compliance with state and federal regulations and to treat and dispose of the wastes in accordance with accepted practice. The cost of UST remediation is prohibitive using some of the current baseline technologies. Furthermore, major gaps exist in key technology areas for processing and disposal of the waste. This DOE remediation effort is one of the most complex and resource-intensive clean-up actions ever attempted by a government agency.

20879 (DOE/CAO–94-2003) **WIPP Regulatory Compliance Strategy and Management Plan for demonstrating compliance to long-term disposal standards.** Westinghouse Electric Corp., Carlsbad, NM (United States). May 1994. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE94012769. Source: OSTI; NTIS; INIS; GPO Dep.

The primary purpose of this document is to provide a strategy by which the WIPP will demonstrate its ability to perform as a deep geologic repository. The document communicates the DOE's understanding of the regulations related to long-term repository performance; and provides the most efficient strategy that intergrates WIPP Project elements, ensures the sufficiency of information, and provides flexibility for changes in the TRU waste generation system to facilitate the disposal of defense-generated TRU wastes. In addition, this document forms a focal point between the DOE and its various external regulators as well as other stakeholders for the purpose of arriving at compliance decisions that consider all relevant input.

20880 (DOE/CAO–94-2004) **Format and Content Guide for Title 40 CFR 191 and Title 40 CFR 268.6 Compliance Reports.** USDOE Carlsbad Area Office, NM (United States). May 1994. 21p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012770. Source: OSTI; NTIS; GPO Dep.

This Format and Content Guide was followed in preparing the WIPP Compliance Status Report submitted in March 1994 and will be used for the compliance documents scheduled for submittal in

the Spring of 1995. The Compliance Status Report was issued to stakeholders in March 1994 and describes the status of associated activities on compliance with the requirements in Title 40 CFR 268.6 and Title 40 CFR 191. The Compliance Status Report focuses on (1) the information required for a demonstration of compliance, (2) preliminary results, (3) the areas of the WIPP program that are either not currently mature enough, or do not provide adequate margin for a demonstration of compliance, and (4) the areas of the WIPP program that will be focused upon to provide the remaining necessary information for use in the 1995 compliance demonstration reports. The Compliance Status Report is not intended to constitute a statement of compliance or a demonstration of compliance. It is intended to report the status of progress made to date in project efforts to achieve the required level of data/information necessary for the required compliance demonstrations. Comments on the Compliance Status Report from stakeholders will likely result in a modified Format and Content Guide, as will the promulgation of the EPA's Compliance Criteria for WIPP (40 CFR 194).

20881 (DOE/EH–231-013/0494) **Transportation of RCRA hazardous wastes: RCRA Information Brief.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Guidance. Apr 1994. 2p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012044. Source: OSTI; NTIS; GPO Dep.

The Resource Conservation and Recovery Act (RCRA) and the Hazardous Materials Transportation Act (HMTA) regulate the transport of hazardous wastes. Under these statutes, specific pretransport regulatory requirements must be met by DOE before the shipment of hazardous wastes, including radioactive mixed wastes. The pretransport requirements are designed to help reduce the risk of loss, leakage, or exposure during shipment of hazardous materials and to communicate information on potential hazards posed by the hazardous material in transport. These goals are accomplished through the tracking of shipments, correctly packaging and labeling containers, and communicating potential hazards. Specific requirements include manifesting, packaging, marking and labeling waste packages; placarding transport vehicles; choosing appropriate waste transporters and shipment destinations; and record keeping and reporting. This information Brief focuses primarily on the transporter requirements both for transportation within a DOE facility and using a commercial transporter to transport RCRA hazardous wastes off-site.

20882 (DOE/EH–231-037/0494) **Pretransport requirements for waste generators: RCRA Information Brief.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Guidance. Apr 1994. 2p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012045. Source: OSTI; NTIS; GPO Dep.

Specific pretransport regulatory requirements must be met by DOE prior to shipment of hazardous waste, low-level wastes (LLW), and radioactive mixed wastes (RMW). The pretransport requirements are intended to help reduce the risk of loss or leakage of, exposure to, hazardous wastes, LLW, and RMW during shipment; and to communicate information on potential hazards to shippers, carriers, or receivers of waste shipments, and emergency response personnel in the event of an accident, spill or leak. These goals are accomplished through tracking of shipments, correct packaging and labeling, and communication of potential hazards. Specific requirements include manifesting, packaging, marking and labeling of waste packages, placarding of vehicles, and selecting appropriate waste transporters and shipment destinations. This Information Brief focuses on the requirements associated with the pretransport of hazardous wastes, LLW, and RMW.

20883 (DOE/EH–231-038/0494) **Manifest requirements: RCRA Information Brief.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Guidance. Apr 1994. 2p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012046. Source: OSTI; NTIS; GPO Dep.

Specific pretransport regulatory requirements must be met by DOE prior to shipment of hazardous waste, low-level wastes (LLW), and radioactive mixed wastes (RMW). The pretransport requirements are intended to help reduce the risk of loss or leakage of, or exposure to, hazardous wastes, LLW, and RMW during shipment; and to communicate information on potential hazards to shippers, carriers, or receivers of waste shipments, and emergency response personnel in the event of an accident, spill, or leak. These goals are accomplished through tracking of shipments, correct packaging and labeling, and communication of potential hazards. Specific requirements include manifesting, packaging, marking and labeling of waste packages, placarding of vehicles, and selecting appropriate waste transporters and shipment destinations. This Information Brief focuses on the manifesting requirements associated with domestic transport of hazardous wastes, LLW, and RMW.

20884 (DOE/EM–0089T-Rev.1(94)) **DOE methods for evaluating environmental and waste management samples.** Goheen, S.C.; McCulloch, M.; Thomas, B.L.; Riley, R.G.; Sklarew, D.S.; Mong, G.M.; Fadeff, S.K. (eds.). Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 671p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012511. Source: OSTI; NTIS; INIS; GPO Dep.

DOE Methods for Evaluating Environmental and Waste Management Samples (DOE Methods) is a resource intended to support sampling and analytical activities for the evaluation of environmental and waste management samples from U.S. Department of Energy (DOE) sites. DOE Methods is the result of extensive cooperation from all DOE analytical laboratories. All of these laboratories have contributed key information and provided technical reviews as well as significant moral support leading to the success of this document. DOE Methods is designed to encompass methods for collecting representative samples and for determining the radioisotope activity and organic and inorganic composition of a sample. These determinations will aid in defining the type and breadth of contamination and thus determine the extent of environmental restoration or waste management actions needed, as defined by the DOE, the U.S. Environmental Protection Agency, or others. The development of DOE Methods is supported by the Laboratory Management Division of the DOE. Methods are prepared for entry into DOE Methods as chapter editors, together with DOE and other participants in this program, identify analytical and sampling method needs. Unique methods or methods consolidated from similar procedures in the DOE Procedures Database are selected for potential inclusion in this document. Initial selection is based largely on DOE needs and procedure applicability and completeness. Methods appearing in this document are one of two types. "Draft" or "Verified.". "Draft" methods that have been reviewed internally and show potential for eventual verification are included in this document, but they have not been reviewed externally, and their precision and bias may not be known. "Verified" methods in DOE Methods have been reviewed by volunteers from various DOE sites and private corporations.

20885 (DOE/EM–0153P) **US - Former Soviet Union environmental restoration and waste management activities, March 1994.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Mar 1994. 49p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012127. Source: OSTI; NTIS; INIS; GPO Dep.

The Peaceful Uses of Atomic Energy Agreement was signed between DOE and the Ministry of Atomic Energy for the Russian Federation and provides a mechanism for cooperation in research, development, and safe utilization of nuclear energy. Under the umbrella of this agreement, DOE and the former Ministry of Atomic Power and Industry signed a Memorandum of Cooperation in the areas of environmental restoration and waste management in September 1990. This document discusses the environmental situation, science and technology process, technical projects (separations, contaminant transport, waste treatment, environmental restoration), scientist exchanges, enhanced data transfer, the US-Russia industry partnership (conference, centers), and future actions.

20886 (DOE/MC/29107–94/C0341) **Bench scale demonstration and conceptual engineering for DETOX℠ catalyzed wet oxidation.** Moslander, J.; Bell, R.; Robertson, D.; Dhooge, P.; Goldblatt, S. Delphi Research, Inc., Albuquerque, NM (United

States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-92MC29107. (CONF-940815–28: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013665. Source: OSTI; NTIS; INIS; GPO Dep.

Laboratory and bench scale studies of the DETOX[SM] catalyzed wet oxidation process have been performed with the object of developing the process for treatment of hazardous and mixed wastes. Reaction orders, apparent rates, and activation energies have been determined for a range of organic waste surrogates. Reaction intermediates and products have been analyzed. Metals' fates have been determined. Bench scale units have been designed, fabricated, and tested with solid and liquid organic waste surrogates. Results from the laboratory and bench scale studies have been used to develop conceptual designs for application of the process to hazardous and mixed wastes.

20887 (DOE/MWIP–25) **Life cycle cost analysis for the Plasma Arc Furnace.** Barnes-Smith, P. Los Alamos National Lab., NM (United States); International Technology Corp., Albuquerque, NM (United States). Mar 1994. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA-UR–94-928). Order Number DE94012310. Source: OSTI; NTIS; GPO Dep.

This document is a draft version. The Mixed Waste Integrated Program requested that the Systems Analysis Group investigate the cost effectiveness of using the Plasma Arc Furnace (PAF) module in place of specified thermal and final forms treatment equipment in the baseline Mixed Waste Treatment Project (MWTP) study as performed by Bechtel Corporation, September 1992. The attached estimates are based on the process equipment and facilities cost data contained in the Bechtel study. The PAF process equipment and facilities cost data were developed using independent cost estimates for the equipment list provided by SAIC, Waste Management and Technology Division, in cooperation with the Pollution Prevention and Systems Analysis Group of the Oak Ridge National Laboratory, Chemical Technology Division. In order to develop the total life cycle cost estimate comparison for this study, it was necessary to use a common base for comparison. Although it was felt that the Bechtel MWTP study did not fully reflect the optimum size for the thermal and final forms treatment equipment, it was the best available data at the time.

20888 (DOE/OR–01-1193-D2) **Quality Assurance Project Plan for the Environmental Monitoring Program in Waste Area Grouping 6 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States); Gilbert/Commonwealth, Inc., Knoxville, TN (United States). Dec 1993. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–3028). Order Number DE94013603. Source: OSTI; NTIS; INIS; GPO Dep.

Waste Area Grouping (WAG) 6 is a hazardous and low-level radioactive waste disposal site at Oak Ridge National Laboratory (ORNL). Extensive site investigations have revealed contaminated surface water, sediments, groundwater, and soils. Based on the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted from 1989–1991 and on recent interactions with the US Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC), a decision was made to defer implementing source control remedial measures at the WAG. The information shows WAG 6 contributes < 2% of the total off-site contaminant risk released over White Oak Dam (WOD). The alternative selected to address hazards at WAG 6 involves maintenance of site access controls to prevent public exposure to on-site contaminants, continued monitoring of contaminant releases to determine if source control measures will be required in the future, and development of technologies to support final remediation of WAG 6. This Quality Assurance Project Plan (QAPjP) has been developed as part of the Environmental Monitoring Plan for Waste Area Grouping 6 at Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/01-1192&D1). Environmental monitoring will be conducted in two phases: the baseline monitoring phase and the routine annual monitoring phase. The baseline monitoring phase will be conducted to establish the baseline contaminant release conditions at the Waste Area Grouping (WAG), to confirm the site-related chemicals of concern (COC), and to gather data to confirm the site hydrologic model. The baseline monitoring phase is expected to begin in 1994 and continue for 12-18 months. The routine annual monitoring phase will consist of continued sampling and analyses of COC to determine off-WAG contaminant flux, to identify trends in releases, and to confirm the COC. The routine annual monitoring phase will continue for ~4 years.

20889 (DOE/RL–93-96) **300-FF-1 operable unit remedial investigation phase II report: Physical separation of soils treatability study.** USDOE Richland Operations Office, WA (United States). Apr 1994. 153p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013011. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the approach and results of physical separations treatability tests conducted at the Hanford Site in the North Process Pond of the 300-FF-1 Operable Unit. Physical separation of soils was identified as a remediation alternative due to the potential to significantly reduce the amount of contaminated soils prior to disposal. Tests were conducted using a system developed at Hanford consisting of modified EPA equipment integrated with screens, hoppers, conveyors, tanks, and pumps from the Hanford Site. The treatability tests discussed in this report consisted of four parts, in which an estimated 84 tons of soil was processed: (1) a pre-test run to set up the system and adjust system parameters for soils to be processed; (2) a baseline run to establish the performance of the system - Test No. 1; (3) a final run in which the system was modified as a result of findings from the baseline run - Test No. 2; and (4) water treatment.

20890 (DOE/RL–94-10-Vol.1-Pt.1) **Hanford Site annual dangerous waste report: Volume 1, Part 1, Generator dangerous waste report dangerous waste: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 532p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012311. Source: OSTI; NTIS; GPO Dep.

This report contains information on hazardous wastes at the Hanford Site. Information consists of shipment date, physical state, chemical nature, weight, waste description, and waste designation.

20891 (DOE/RL–94-10-Vol.1-Pt.2) **Hanford Site annual dangerous waste report: Volume 1, Part 2, Generator dangerous waste report dangerous waste: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 533p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012312. Source: OSTI; NTIS; GPO Dep.

This report contains information on hazardous wastes at the Hanford Site. Information consists of shipment date, physical state, chemical nature, weight, waste description, and waste designation.

20892 (DOE/RL–94-10-Vol.2) **Hanford Site annual dangerous waste report: Volume 2, Generator dangerous waste report radioactive mixed waste: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 507p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012313. Source: OSTI; NTIS; GPO Dep.

This report contains information on radioactive mixed wastes at the Hanford Site. Information consists of shipment date, physical state, chemical nature, weight, waste description, and waste designation.

20893 (DOE/RL–94-10-Vol.3-Pt.1) **Hanford Site annual dangerous waste report: Volume 3, Part 1, Waste management facility report dangerous waste: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 356p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012314. Source: OSTI; NTIS; GPO Dep.

This report contains information on hazardous wastes at the Hanford Site. Information consists of shipment date, physical state, chemical nature, waste description, handling method and containment vessel, waste number, waste designation, and amount of waste.

20894 (DOE/RL–94-10-Vol.3-Pt.2) **Hanford Site annual dangerous waste report: Volume 3, Part 2, Waste management**

facility report dangerous waste: Calendar Year 1993. USDOE Richland Field Office, WA (United States). [1993]. 316p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012315. Source: OSTI; NTIS; GPO Dep.

This report contains information on hazardous wastes at the Hanford Site. Information consists of shipment date, physical state, chemical nature, waste description, handling method and containment vessel, waste number, waste designation, and amount of waste.

20895 (DOE/RL–94-10-Vol.4) **Hanford site annual dangerous waste report: Volume 4, Waste management facility report radioactive mixed waste: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 342p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012316. Source: OSTI; NTIS; GPO Dep.

This report contains information on hazardous waste at the Hanford site. Information consists of shipment date, physical state, chemical nature, waste description, handling method and containment vessel, waste number, waste designation, and amount of waste.

20896 (DOE/RL–94-10-Vol.5) **Hanford Site annual dangerous waste report: Volume 5, Supplement waste minimization report: Calendar Year 1993.** USDOE Richland Field Office, WA (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012317. Source: OSTI; NTIS; GPO Dep.

This report contains procedures by which generated wastes were minimized or eliminated.

20897 (DOE/RL–94-21) **1994 Report on Hanford Site land disposal restrictions for mixed waste.** Black, D.G. USDOE Richland Operations Office, WA (United States). Apr 1994. 222p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013580. Source: OSTI; NTIS; INIS; GPO Dep.

The baseline land disposal restrictions (LDR) plan was prepared in 1990 in accordance with the Hanford Federal Facility Agreement and Consent Order (commonly referred to as the Tri-Party Agreement) Milestone M-26-00 (Ecology et al. 1992). The text of this milestone is below. LDR requirements include limitations on storage of specified hazardous wastes (including mixed wastes). In accordance with approved plans and schedules, the US Department of Energy (DOE) shall develop and implement technologies necessary to achieve full compliance with LDR requirements for mixed wastes at the Hanford Site. LDR plans and schedules shall be developed with consideration at other action plan milestones and will not become effective until approved by the US Environmental Protection Agency (EPA) (or Washington State Department of Ecology [Ecology]) upon authorization to administer LDRs pursuant to Section 3006 of the Resource Conservation and Recovery Act of 1976 (RCRA). Disposal of LDR wastes at any time is prohibited except in accordance with applicable LDR requirements for nonradioactive wastes at all times. The plan will include, but not be limited to, the following: waste characterization plan; storage report; treatment report; treatment plan; waste minimization plan; a schedule depicting the events necessary to achieve full compliance with LDR requirements; a process for establishing interim milestones. The original plan was published in October 1990. This is the fourth of a series of annual updates required by Tri-Party Agreement Milestone M-26-01. A Tri-Party Agreement change request approved in March 1992 changed the annual due date from October to April and consolidated this report with a similar one prepared under Milestone M-25-00. The reporting period for this report is from April 1, 1993, to March 31, 1994.

20898 (DOE/RL/10382–6) **Decontamination and decommissioning of the Kerr-McGee Cimarron Plutonium Fuel Plant.** USDOE Richland Operations Office, WA (United States). [1994]. 166p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-83RL10382. Order Number DE94011969. Source: OSTI; NTIS; GPO Dep.

This final report is a summary of the events that completes the decontamination and decommissioning of the Cimarron Corporation's Mixed Oxides Fuel Plant (formally Sequoyah Fuels Corporation and formerly Kerr-McGee Nuclear Corporation - all three wholly owned subsidiaries of the Kerr-McGee Corporation). Included are details dealing with tooling and procedures for performing the unique tasks of disassembly decontamination and/or disposal. That material which could not be economically decontaminated was volume reduced by disassembly and/or compacted for disposal. The contaminated waste cleaning solutions were processed through filtration and ion exchange for release or solidified with cement for L.S.A. waste disposal. The L.S.A. waste was compacted, and stabilized as required in drums for burial in an approved burial facility. T.R.U. waste packaging and shipping was completed by the end of July 1987. This material was shipped to the Hanford, Washington site for disposal. The personnel protection and monitoring measures and procedures are discussed along with the results of exposure data of operating personnel. The shipping containers for both T.R.U. and L.S.A. waste are described. The results of the decommissioning operations are reported in six reports. The personnel protection and monitoring measures and procedures are contained and discussed along with the results of exposure data of operating personnel in this final report.

20899 (DOE/RL/11946–T1-Vol.1) **Waste Receiving and Processing Facility Module 2A: Advanced Conceptual Design Report: Volume 1.** United Engineers and Constructors, Inc., Englewood, CO (United States). Western Operations. Mar 1994. 271p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-91RL11946. Order Number DE94012831. Source: OSTI; NTIS; GPO Dep.

Engineering drawings for this project are identified as CAPE–3079. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

This ACDR was performed following completed of the Conceptual Design Report in July 1992; the work encompassed August 1992 to January 1994. Mission of the WRAP Module 2A facility is to receive, process, package, certify, and ship for permanent burial at the Hanford site disposal facilities the Category 1 and 3 contact handled low-level radioactive mixed wastes that are currently in retrievable storage at Hanford and are forecast to be generated over the next 30 years by Hanford, and waste to be shipped to Hanford from about DOE sites. This volume provides an introduction to the ACDR process and the scope of the task along with a project summary of the facility, treatment technologies, cost, and schedule. Major areas of departure from the CDR are highlighted. Descriptions of the facility layout and operations are included.

20900 (DOE/RL/11946–T1-Vol.2) **Waste Receiving and Processing Facility Module 2A: Advanced Conceptual Design Report: Volume 2.** United Engineers and Constructors, Inc., Englewood, CO (United States). Western Operations. Mar 1994. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-91RL11946. Order Number DE94012832. Source: OSTI; NTIS; GPO Dep.

Engineering drawings for this project are identified as CAPE–3079. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

This volume presents the Total Estimated Cost (TEC) for the WRAP (Waste Receiving and Processing) 2A facility. The TEC is $81.9 million, including an overall project contingency of 25% and escalation of 13%, based on a 1997 construction midpoint. (The mission of WRAP 2A is to receive, process, package, certify, and ship for permanent burial at the Hanford site disposal facilities the Category 1 and 3 contact handled low-level radioactive mixed wastes that are currently in retrievable storage, and are forecast to be generated over the next 30 years by Hanford, and waste to be shipped to Hanford site from about 20 DOE sites.)

20901 (DOE/RL/11946–T1-Vol.3A) **Waste Receiving and Processing Facility Module 2A: Advanced Conceptual Design Report: Volume 3A.** United Engineers and Constructors, Inc., Englewood, CO (United States). Western Operations. Mar 1994. 1266p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-91RL11946. Order Number DE94012833. Source: OSTI; NTIS; GPO Dep.

Engineering drawings for this project are identified as CAPE-3079. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

Objective of this document is to provide descriptions of all WRAP 2A feed streams, including physical and chemical attributes, and describe the pathway that was used to select data for volume estimates. WRAP 2A is being designed for nonthermal treatment of contact-handled mixed low-level waste Category 1 and 3. It is based on immobilization and encapsulation treatment using grout or polymer.

20902 (DOE/RL/11946–T1-Vol.3B) **Waste Receiving and Processing Facility Module 2A: Advanced Conceptual Design Report: Volume 3B.** United Engineers and Constructors, Inc., Englewood, CO (United States). Western Operations. Mar 1994. 564p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-91RL11946. Order Number DE94012834. Source: OSTI; NTIS; GPO Dep.

Engineering drawings for this project are identified as CAPE-3079. Inquiries may be directed to: Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831.

This volume consists of the following sections: WRAP 2A value engineering assessment, resolution of value engineering assessment actions (white paper), HAZOP studies for identifying major safety and operability problems, and time and motion simulation.

20903 (DOE/SR/18159–3) **The effect of soil mineral phases on the abiotic degradation of selected organic compounds: Progress report, June 31, 1990–May 31, 1993.** Sandhu, S.S. Claflin Coll., Orangeburg, SC (United States). 31 May 1993. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-90SR18159. Order Number DE94012489. Source: OSTI; NTIS; GPO Dep.

Tetraphenylborate (TPB) is used to precipitate radioactive 137Cs from high-level nuclear waste water at the Defense Waste Processing Facility (DWPF) operated by the US DOE at the Savannah River Plant (SRP). The process is part of the procedure for the glassification of high-level nuclear waste in preparation for its long-term geological disposal. The decontaminated waste water contains millimolar quantities of TPB that will be processed into salt concretions. The transporation and use of large amounts of TPB can potentially result in the release of TPB into soil or aquatic environments. Previous study has shown that TPB degrades in soils to initially form diphenylborinic acid (DPBA) and biphenyl. DPBA appears to degrade further into other unidentified compounds which subsequently degrade into inorganic boron. The factors which promote the abiotic degradation of TPB need to be investigated since this chemical is used in the processing of radioactive wastes. TPB and its intermediate product, DPBA, have been reported to be toxic to microorganisms and plants, dependent on soil or water environments for their survival and growth.

20904 (DPW–54-4-7) **200 Area weekly report.** Hood, J.F. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 17 Feb 1954. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–725). Order Number DE94011769. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SAVANNAH RIVER PLANT/radioactive waste facilities; GASKETS; SOLVENT EXTRACTION; TRITIUM; WASTE PROCESSING; SPECIAL PRODUCTION REACTORS

20905 (DPW–55-291) **Reduction of waste storage costs.** Thayer, V.R. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 23 Jun 1955. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–728). Order Number DE94012124. Source: OSTI; NTIS; GPO Dep.

This memorandum covers the results of a study aimed at recommending a general course of action on waste handling and storage at Savannah River. It is the intent of the study to develop recommendations applying to the immediate needs for additional waste storage capacity, to plant tests of methods for reducing waste volumes to engineering design and development aimed at future economies, and to research on longer term phases of the program. It is further intended that steps recommended for the immediate future be such as to permit taking maximum advantage of late developments.

20906 (EGG–11265-2027) **The Reclamation Program of the treatability studies for soil media project.** EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. 20 Oct 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-9310276–8: 8. wildland shrub and arid land restoration symposium, Las Vegas, NV (United States), 19-21 Oct 1993). Order Number DE94013567. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy is sponsoring a research and demonstration program on the Nevada Test Site to develop and test an optimized cleanup system for large-area, surface plutonium contamination. The project addresses three principle areas: vegetation and soil removal, volume reduction of the displaced soil, and site restoration consisting of soil stabilization and revegetation. Soil stabilization and revegetation are critical in order to prevent erosion and reestablish wildlife habitat. A series of field and laboratory studies have been initiated to develop technologies to stabilize and restore sites disturbed by TSSM activities. Soil stabilization studies will test suitable techniques and materials to control wind and water erosion. Revegetation studies will focus on determining suitable plant species, proper techniques for establishing plants by direct seeding, procedures for transplanting native shrubs, soil fertility and irrigation requirements, and effects of herbivory on plant establishment. Additional studies will determine the extent of plutonium contamination on native vegetation, and the potential for removing plutonium from vegetation. Laboratory and greenhouse studies will determine effects of plutonium decontamination processes on soil microbial populations, and the effects of gravel mulches and soil texture on plant establishment. Following completion of these studies, the most promising technologies will be demonstrated on a larger scale at actual contaminated sites on the NTS.

20907 (ENRESA–10/93) **Methods and results of the investigation of the thermomechanical behaviour of rock salt with regard to the final disposal of high-level radioactive wastes.** Wieczorek, K. (Institut fur Tieflagerung (GEC)); Klarr, K. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung. 1993. 115p. Order Number DE94770468. Source: OSTI; NTIS.

This report summarizes the knowledge about thermal and mechanical behaviour of rock salt that has been accumulated by various R and D institutions in Germany from laboratory and in situ investigations. An important objective is to give a comprehensive overview of the investigation methods and instruments available and to discuss these methods and instruments with regard to their applicability and reliability for the investigation of the thermomechanical effects of high level radioactive waste emplacement in rock salt formations. The report is focused on the activities of the GSF-Institut fur Tieflagerung in the Asse mine regarding the disposal of high and intermediate level radioactive waste during the last decades. The design and the results of the most important in situ experiments are presented and discussed in detail. The results are compared to model calculations in order to evaluate the reliability of both the measurements and the calculation results. The relevance of the results for the situation in Spain is discussed in a separate chapter. As the investigations in Germany have been performed in domal salt, while the Spanish concept is based on waste disposal in bedded salt, significant differences in the thermomechanical behaviour cannot be excluded. The investigation methods, however, will be applicable. (Author)

20908 (GSF–9/93) **Radiation effects in rock salt: Status report.** Gies, H.; Hild, W.; Kuehle, T.; Moenig, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung. 1993. 170p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT KWA5901; Foerderkennzeichen BMFT 02E8532 Order Number DE94773759. Source: OSTI; NTIS (US Sales Only); INIS.

Knowledge of the irradiation defects and the accompanying energy storage in rock salt resulting from the absorption of ionizing radiation emitted by vitrified high level radioactive waste (HLW) disposed off in geological rock salt formations is an important prerequisite for a realistic assessment of possible consequences. Based on a critical review of the scientific status this report attempts

to evaluate whether the available database is satisfactory and sufficiently reliable for the performance of such an assessment. (orig.)

20909 (GSF–21/93) **Measurement and evaluation of the water and the salt solutions occurring in the exploitation of rock salt, potash or copper shale deposits in the Bernburg Hauptsattel or the Sangerhaeuser Revier in order to assess the long-term safety of repositories.** Schwandt, A. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung. 1993. 235p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 02E8341. (GSF-TL–35/93). Order Number DE94774128. Source: OSTI; NTIS (US Sales Only); INIS.

For a thorough assessment of conditions governing the occurrence of salt solutions or water in a repository in the Zechstein, i.e. in the salt formation and at its boundaries, data measured in other mines developed in this formation can yield valuable information. The studies reported were based on geological, hydrogeological, geochemical and geomechanical data collected for more than 50 inflow areas or salt solution bearing areas, covering approx. 15,000 chemical or physical analyses from which the data were derived describing the characteristics or development of inflow streams with time. In addition, the mapped inflow streams were evaluated with a view to the geological and hydrogeological and the geomechanical conditions of origin, as well as engineering impacts. (DG)

20910 (GSF–26/93) **Studies on direct ultimate disposal of spent fuel elements. Pt. 1: Thermal simulation of drift emplacement. Reported period: October 1, 1990 to December 31, 1992.** Schneefuss, J.; Droste, J.; Gommlich, G.; Ohme, G.; Jockwer, N.; Moenig, J.; Kunze, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung. 1993. 251p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 02E8211; Foerderkennzeichen BMFT KWA5702 Order Number DE94774129. Source: OSTI; NTIS (US Sales Only); INIS.

The activities reported encompass the demonstration and optimization of the backfilling technique applied for waste emplacement in drifts, the validation of thermal and thermomechanical models, and the simulation of the thermomechanical interactions between waste product dummies, backfilling material and surrounding rock. The current status of work and the results describing the thermal and thermomechanical reactions of backfill and rock are given, as well as the results of in situ density measurements in the backfill and of gas formation. The data have been recorded and processed for a central database. (DG)

20911 (HDC–743) **200 Area stack contamination: Interim report, August 2, 1948–October 11, 1948.** Lapple, C.E. Hanford Works, Richland, WA (United States). 11 Oct 1948. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94009778. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In connection with the problem of eliminating contamination of the atmosphere by the exhaust from the 221 Building ventilation air stacks, sand filters were previously recommended. Construction of a sand filter in West Area is about completed and construction of a filter in East Area is well underway. This report summarizes the status, technical findings, and comments and suggestions since the writer's last Interim Report, dated August 6, 1948, was issued.

20912 (HW–25273) **Storage of radioactive aqueous wastes from Purex processes.** Platt, A.M.; Krieg, J.T. Pacific Northwest Lab., Richland, WA (United States). 1 Aug 1952. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013682. Source: OSTI; NTIS; GPO Dep.

The radioactive liquid wastes from a separations facility are customarily stored in underground waste storage tanks. The wastes from the proposed Purex Separations Plant will have a high concentration of the fission products and will result in a large evolution of heat. The possibility of these wastes boiling due to radiodisintegration of fission products has made a survey of the problem desirable. This report lists the results of this investigation.

20913 (HW–30399) **TBP plant nickel ferrocyanide scavenging flowsheet.** Sloat, R.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Jan 1954. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (HAN–54133). Order Number DE94006080. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Recent plant-scale scavenging and cribbing tests have confirmed laboratory data which indicated that the cesium and strontium in TBP wastes could be reduced by nickel ferrocyanide scavenging to concentrations which permit discharge of the scavenged supernatant to cribs. In this document a chemical flowsheet is presented for use as a design basis for facilities which will permit scavenging of unconcentrated neutralized waste for the TBP Plant.

20914 (HW–32716) **Decontamination of bismuth phosphate process first cycle and coating removal wastes.** Burns, R.E. Hanford Works, Richland, WA (United States). 10 Aug 1954. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006714. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Recent successes with the use of metal ferrocynanides, particularly nickel ferrocyanide, for the removal of cesium from Uranium Recovery Process wastes prompted an investigation into the use of this carrier for the removal of cesium from wastes produced in the coating-removal and first-decontamination-cycle steps of the Bismuth Phosphate Process. Both in-line treatment of the wastes currently produced and treatment of supernatant liquids from wastes already stored in underground tanks were considered.

20915 (HW–33184) **$BiPO_4$ plant nickel ferrocyanide scavenging flowsheet for first-cycle waste containing no coating-removal waste.** Coppinger, E.A.; Smith, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Sep 1954. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006716. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Management of first-cycle wastes from the Bismuth Phosphate Plant using Nickel Ferrocyanide scavenging is described.

20916 (HW–33536) **Nickel ferricyanide scavenging flowsheet for neutralized concentrated raw.** Smith, R.E.; Coppinger, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Oct 1954. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006082. Source: OSTI; NTIS (US Sales Only); GPO Dep.

From the startup of the TBP Plant until late in September, 1954, when in-line scavenging operations were begun, the wastes from the TBP Plant had been stored after neutralization and concentration in underground storage tanks. Some of this TBP waste has been given a secondary concentration in the waste concentration facilities (first cycle waste evaporators) at the tank farms. Studies by the chemistry Unit have indicated that a further reduction in the volume of waste permanently stored is possible by scavenging these wastes. In this document, a chemical flowsheet is presented for use as a design basis of facilities which will permit scavenging of these stored wastes.

20917 (HW–34860) **A study to determine the economical tank size for radioactive waste disposal.** Stivers, H.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Feb 1955. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012019. Source: OSTI; NTIS; GPO Dep.

Purpose of this report is to determine optimum tank size from evaluating the quantities of principal construction materials with prevailing unit costs for various tank sizes. The materials were concrete in-place, reinforcing steel in-place, wood framework, 3/8 in. C steel plate liner in-place, earthwork excavation and backfill (engineering, overhead, piping, condenser, vapor manifold costs not included). Costs of optimum tank are distributed as follows: dome 25%, walls 28%, foundation 6%, floor 2%, steel liner 20%, earthwork 19%. For a given tank capacity, there is a definite optimum tank size; as the capacity increases, the diameter increases, and the height increases but at a lesser rate. Each diameter has

an optimum height, which is that height at which unit cost of storage space is minimum for a given tank diameter. Optimum unit cost is $0. 136/gallons for diameters 75-130 ft; for diameters<75 ft, the optimum unit increases. Tank forms 241-S, 241-SX, and 241-A were used in this study; storage cost of the analyzed tank was $0.121 compared to $0.136/gallon for 241-SX and 241-A, and $0.152/gallon for 241-S. Assumed unit costs for concrete and steel plate tank liner were 10% less than those of 241-SX and 241-A, causing the lower unit costs. Tanks used for 241-SX and 241-A are close to optimum tank size. Although a small savings in storage unit cost will result from optimum dimensions, greater savings could be realized by increasing the tank capacity 20-25% without changing tank diameter or storage unit cost. Curves in the appendix can be used to select optimum tanks for new tank farms.

20918 (HW–64156) **Design study interim report, RMA button line radiation reduction.** Kolb, J.W.; Bellarts, H.J. Pacific Northwest Lab., Richland, WA (United States). 1 Apr 1960. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013675. Source: OSTI; NTIS; GPO Dep.

The design approach followed in this study is that of handling and processing plutonium solution and powders within tightly sealed but readily replaceable units of processing equipment, each one of which will do one step in the overall process. The presently used method is to use open equipment enclosed in glove boxes attached to a transporting device. Elimination of the glove box enclose and its replacement by tightly sealed and detachable equipment provides the accessability necessary for equipment repair and reduction of down time, thereby reducing costs. Most of the primary functions for the entire button line have been studied and no insurmountable design problems have been encountered. Studies of the pre-reduction and filtrate treatment functions and the PR can unloading and RC can loading equipment have been summed up and compiled into a design criteria. Design concepts for all of the equipment for processing from the nitrate through the button stage have been worked out and appear to be acceptable approaches, except for the vacuum drum filter and the vibrating tube reactor. The latter two components have been studied and drawings prepared; however, the concepts developed are not considered entirely acceptable from the operation and maintenance standpoint. Because of these shortcomings, alternative approaches are being considered for both components. Present plans call for investigation of a newly developed 6-inch continuous centrifuge to replace the vacuum drum filter, and a ribbon screw-type reactor to replace the vibrating tube. Both substitutions are to be verified by a testing program.

20919 (HW–69068) **In-tank solidification of intermediate-activity wastes.** Campbell, B.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Apr 1961. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011981. Source: OSTI; NTIS; GPO Dep.

Declassified.

Solidification of intermediate-activity wastes is a major goal of the CPD Waste Management Program. Plans are to reduce the wastes, by evaporation, to salt cakes in existing tanks, thereby insuring safe, long-term storage of contained fission products regardless.of tank integrity. Initiation of these plans at an early date is necessary to offset the expected increase in tank failures and to provide space for future wastes. Major decisions of the program relate to selection of the evaporative method to be employed. The requirements of in-tank solidification were therefore reviewed to determine if the choice of evaporative systems can be made at this time. The relative potential of Bentube evaporation and submerged combustion for meeting these requirements were analyzed on the basis of available information, including actual performance of the Bentube facility at the Savannah River Plant (SRP).

20920 (HW–70361) **The processing of Pu scrap at Hanford.** Grimm, K.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Jul 1961. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012031. Source: OSTI; NTIS; GPO Dep.

Declassified.

This study responds to the requests for data on the subject contained in the D.S. Burrows letter entitled "Processing Plutonium Scrap" (symbol FAc:EAS) dated June 30, 1961 and received for reading by Chemical Processing Department Management on July 5, 1961. Cognizance is also taken of the July 5 teletype from G.F. Quinn requesting an appendix updating the content of our document HW-63560 (Pu Reclamation – January 18, 1960) with regard to safety aspects covered therein. Appendix A of this paper answers this request.

20921 (HW–83725) **Fiscal 1965 revision of cesium-137 index for nuclear materials content of coating waste.** Zimmer, W.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Aug 1964. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010967. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. PUREX PROCESS/radioactive wastes; REDOX PROCESS/radioactive wastes; HAPO; CESIUM 137; COATINGS; DISSOLVERS; MATHEMATICAL MODELS

20922 (ISO–98) **Radioactive contamination in liquid wastes discharged to ground at the separations facilities through December, 1965.** McMurray, B.J. Isochem Inc., Richland, WA (United States). 15 Feb 1966. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007902. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document summarizes the amounts of radioactive contamination discharged to ground from chemical separations and laboratory facilities through December 1965. Detailed data for individual disposal sites are presented on a month-to-month basis for the period of January through December 1965. Previous publications of this series are listed in the bibliography and may be referred to for specific information on measurements and radioactivity totals prior to January 1965. Several changes in crib nomenclature were made during 1965. These changes are noted on the individual tables so reference may be made to them in previous reports.

20923 (ISO–698) **Radioactive contamination in liquid wastes discharged to ground at the separations facilities through December, 1966.** McMurray, B.J. Isochem Inc., Richland, WA (United States). 15 Feb 1967. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007903. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document summarizes the amounts of radioactive contamination discharged to ground from chemical separations and laboratory facilities through December, 1966. Detailed data for individual disposal sites are presented on a month-to-month basis for the period of January through December, 1966. Previous publications of this series are listed in the bibliography and may be referred to for specific information on measurements and radioactivity totals prior to January, 1966. Several changes in crib nomenclature were made during 1965. These changes are noted on the individual tables so reference may be made to them in previous reports.

20924 (Juel–2831) **Incineration plant for low active waste at Inshass, LAWI.** Krug, W. (Forschungszentrum Juelich GmbH (Germany). Zentralabteilung Forschungsreaktoren und Kerntechnische Betriebe); Thoene, L.; Schmitz, H.J.; Abdelrazek, I.D. Forschungszentrum Juelich GmbH (Germany). Zentralabteilung Forschungsreaktoren und Kerntechnische Betriebe. Oct 1993. 60p. (In German, English). Order Number DE94773792. Source: OSTI; NTIS (US Sales Only); INIS.

German-Egyptian cooperation in scientific research and technological development.

The LAWI (Low Active Waste Incinerator) prototype incinerating plant was devised and constructed according to the principle of the Juelich thermoprocess and installed at the Egyptian research centre Inshass. In parallel, AEA Cairo devised and constructed their own operations building for this plant with all the features, infrastructural installations and rooms required for operating the plant and handling and treating low-level radioactive wastes. The dimensions of this incinerator were selected so as to be sufficient for the

disposal of solid, weakly radioactive combustible wastes from the Inshass Research Centre and the environment (e.g. Cairo hospitals). (orig./DG)

20925 (KCP–613-5329) **Department of Energy's process waste assessment graded approach methodology.** Pemberton, S.E. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Mar 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-940859–8: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008707. Source: OSTI; NTIS; INIS; GPO Dep.

As the initial phase of the formal waste minimization program, the Department of Energy requires assessments of all its waste-generating operations. These assessments, called process waste assessments (PWAs), are a tool which helps achieve the pollution prevention goals. The DOE complex is comprised of numerous sites located in many different states. The facilities as a whole represent a tremendous diversity of technologies, processes, and activities. Due to this diversity, there are also a wide variety and number of waste streams generated. Many of these waste streams are small, intermittent, and not of consistent composition. The PWA graded approach methodology addresses these complexities and recognizes that processes vary in the quantity of pollution they generate, as well as in the perceived risk and associated hazards. Therefore, the graded approach was developed to provide a cost-effective and flexible methodology which allows individual sites to prioritize their local concerns and align their efforts with the resources allocated. This presentation will describe a project sponsored by the DOE Office of Environmental Restoration and Waste Management, Waste Minimization Division, which developed a graded approach methodology for use throughout the DOE. This methodology was initiated in FY93 through a combined effort of the following DOE/Defense Program sites: Kansas City Plant, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories. This presentation will describe the process waste assessment tool, benefits achieved through the completion of PWAs, DOE's graded approach methodology, and an update on the project's current status.

20926 (KFK–5278) **Development of a technical process concerning the immobilisation of nuclear waste by embedding into ceramic matrix.** Schubert, G.; Krause, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Dec 1993. 57p. (In German). Order Number DE94773749. Source: OSTI; NTIS (US Sales Only); INIS.

Ceramic is considered a highly qualified matrix for the embedding of all radioactive waste concentrates arising from reprocessing and fabricating UO_2/PuO_2-mixed oxide fuel elements and it may take up all long-lived or highly active radionuclides. Parallel to product development a technically feasible process has been started. The wastes are mixed with the ceramics-forming agents in a wet medium. A double-shaft extruder may be used. Backfitting of the extruder for use in a hot cell may be carried out easily. Experiments are presented and conceptions developed as to how the facility may be designed under aggravated boundary conditions of irradiation and remote handling. The process consists of the following stages: Preliminary treatment of the four waste suspensions, without dehydration; continuous dosage into a double-shaft extruder, where preliminary drying and then addition of the fifth waste type (dry ash) as well as of the mixture of ceramics-forming agents takes place; mixing and preferably extrusion. Heat treatment from the drying and calcination temperatures up to the sintering temperature of 1250-1300 C in a stationary heated electric furnace, filling of the hot material into canisters, filling of the cavities with liquid glas, and sealing of the cansiters. Except for an experiment with dissolver residues, all experiments were inactive. Conventional devices were applied with the aim of investigated their suitability for the process as well as for the conditions of remote handling and inrradiation. A facility, which was to be located downstream of a 350 t/a reprocessing plant, would have to have a throughput of about 40 kg/h ceramic product or 6 canisters per day. (orig./HP)

20927 (K/TCD–1080) **Solidification of waste sludges using microwave heating.** Del Cul, G.D. (Oak Ridge K-25 Site, TN (United States)); Bostick, W.D.; Adamski, R.E.; Slover, W.A.; Osborne, P.E.; Fellows, R.L.; White, T.L. Oak Ridge K-25 Site, TN (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. (CONF-940528–2: Incineration conference: 13th international symposium on thermal treatment technologies, Houston, TX (United States), 9-13 May 1994). Order Number DE94011050. Source: OSTI; NTIS; GPO Dep.

A laboratory-scale microwave heating system is used to demonstrate the feasibility of drying and then solidifying surrogate and authentic waste water treatment residuals. Depending upon the glass formers present in (or added to) the sludge sample, the resultant waste form is a brick-like ceramic, a stone-like monolith, or an amphorous glass. Compared to the original wet sludge slurry, the refractory, high-density waste forms represent a large volume reduction (often by a factor of 5 to 10) and show enhanced leach resistance for regulated metals. As described in the text, microwave waste processing is perceived as offering numerous advantages over conventional thermal treatment technology.

20928 (LA–12751-MS) **Waste minimization and the goal of an environmentally benign plutonium processing facility: A strategic plan.** Pillay, K.K.S. Los Alamos National Lab., NM (United States). Feb 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94008791. Source: OSTI; NTIS; INIS; GPO Dep.

To maintain capabilities in nuclear weapons technologies, the Department of Energy (DOE) has to maintain a plutonium processing facility that meets all the current and emerging standards of environmental regulations. A strategic goal to transform the Plutonium Processing Facility at Los Alamos into an environmentally benign operation is identified. A variety of technologies and systems necessary to meet this goal are identified. Two initiatives now in early stages of implementation are described in some detail. A highly motivated and trained work force and a systems approach to waste minimization and pollution prevention are necessary to maintain technical capabilities, to comply with regulations, and to meet the strategic goal.

20929 (LA–12780-MS) **Molecular models for actinide speciation.** Clark, D.L.; Watkin, J.G.; Morris, D.E.; Berg, J.M. Los Alamos National Lab., NM (United States). Jun 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012370. Source: OSTI; NTIS; INIS; GPO Dep.

Much effort has been devoted to the development of sensitive spectroscopic techniques for the study of actinide speciation based on the sensitivity of f-f electronic absorption bands to oxidation state and ligation of the actinide ions. These efforts assume that data obtained in such studies will be interpretable in terms of changes in complexation of the metal center. However, the current understanding of 5f electronic structure is based on data from solid state doped single crystals. In those studies, the local coordination geometry about the central actinide ion is maintained in an almost perfect high-symmetry environment and will have little relevance for species in solution where deviations from perfect high symmetry tend to be the rule rather than the exception. The authors have developed a vigorous research program in the systematic preparation and spectroscopic characterization of synthetic actinide complexes (Th, U, Np, and Pu) in which they can control nuclearity, oxidation state, and molecular structure. These complexes have been used to determine how observable electronic transitions are perturbed in response to structural changes in the complex in solution. From the spectra obtained for these model complexes, the authors have found that the f-f transitions naturally fall into obvious groupings by coordination number and symmetry by which they can now differentiate between monomeric, dimeric, and trimeric species in solution. The study of radionuclide speciation is fundamentally important to the determination of radionuclide solubility in the groundwater at Yucca Mountain.

20930 (LA-UR–94-1027) **Development of on-line energy dispersive x-ray fluorescence to monitor actinide-contaminated waste streams.** Day, R.S.; Vigil, A.R. Los Alamos National Lab., NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36.

(CONF-940401–8: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94011649. Source: OSTI; NTIS; INIS; GPO Dep.

A commercially available on-line energy dispersive x-ray fluorescence (EDXRF) system has been modified for glove-box operations and installed on the Advanced Testing Line for Actinide Separations (ATLAS) at Los Alamos. The goal is to quantitatively monitor actinides and metal impurities in an anion-exchange effluent to obtain near-real-time chemical information. Because of recent compliance issues, metals listed in the Resource Conservation and Recovery Act and other low-level radioactive components are also being analyzed. Initial experiments on how preconcentration techniques can be applied to on-line EDXRF measurements for improved detection limits have also been conducted. An overview of these developments is presented in this paper.

20931 (LA-UR–94-1093) **Cobalt dicarbollide containing polymer resins for cesium and strontium uptake.** Steckle, W.P. Jr.; Duke, J.R. Jr.; Jorgensen, B.S. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940813–2: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94009326. Source: OSTI; NTIS; INIS; GPO Dep.

Cobalt(III) dicarbollide $[(C_2B_9H_{11})_2Co]^-$ (CB_2) is being investigated for Cs and Sr extraction from nuclear waste. Because organic solvents should be avoided, bonding of CB_2 to resins were investigated. CB_2 was successfully covalently bonded to polystyrene and polybenzimidazole resins. Tetrahydrofuran was the most efficient solvent for grafting. Analysis is being performed, and separation coefficients are also being determined. 3 figs, 8 refs.

20932 (LA-UR–94-1561) **Scale-up of the SY-102 remediation flowsheet.** Punjak, W.A.; Yarbro, S.L.; Schreiber, S.B.; Dunn, S.L.; Ortiz, E.M.; Day, R.S.; Thomas, K.W. Los Alamos National Lab., NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940813–6: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94012898. Source: OSTI; NTIS; INIS; GPO Dep.

An anion exchange unit operation for the removal of actinides from a high nitrate-low acid solution has been successfully scaled-up more than one order of magnitude. The behavior of the scaled-up system was similar in many ways to the previous small scale experiments. It is characterized by a slow approach to equilibrium, displacement of Am by the other actinides, and improved column performance with increasing column length. The breakthrough of Americium, the most weakly sorbed actinide of those present, was predicted for the larger system with reasonable accuracy.

20933 (LA-UR–94-1735) **Reductive dissolution approaches to removal of uranium from contaminated soils.** Brainard, J.R.; Iams, H.D.; Strietelmeier, B.A.; Del-Rio Garcia, M. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940225–113: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94012926. Source: OSTI; NTIS; INIS; GPO Dep.

Traditional approaches to uranium recovery from ores have employed oxidation of U(IV) minerals to form the uranyl cation which is subsequently complexed by carbonate or maintained in solution by strong acids. Reductive approaches for uranium decontamination have been limited to removing soluble uranium from solutions by formation of U^{4+} which readily hydrolyses and precipitates. As part of the Uranium in Soils Integrated Demonstration, we have developed a reductive approach to solubilization of uranium from contaminated soils which employs reduction to destabilize U(VI) solid and sorbed species, and strong chelators for U(IV) to prevent hydrolysis and solubilize the reduced from. This strategy has particular application to sites where the uranium is present primarily as intractable U(VI) phases and where high fractions of the contamination must be removed to meet regulatory requirements.

20934 (LBL–35186) **Phenomenological studies of two-phase flow processes for nuclear waste isolation.** Pruess, K.; Finsterle, S.; Persoff, P.; Oldenburg, C. Lawrence Berkeley Lab., CA (United States). Jan 1994. 9p. Sponsored by USDOE, Washington, DC (United States);Swiss National Cooperative for the Storage of Nuclear Waste, Baden (Switzerland). DOE Contract AC03-76SF00098. (CONF-940553–47: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94011350. Source: OSTI; NTIS; INIS; GPO Dep.

The US civilian radioactive waste management program is unique in its focus on a site in the unsaturated zone, at Yucca Mountain, Nevada. Two-phase flow phenomena can also play an important role in repositories beneath the water table where gas is generated by corrosion, hydrolysis, and biological degradation of the waste packages. An integrated program has been initiated to enhance our understanding of two-phase flow behavior in fractured rock masses. The studies include two-phase (gas-liquid) flow experiments in laboratory specimens of natural rock fractures, analysis and modeling of heterogeneity and instability effects in two-phase flow, and design and interpretation of field experiments by means of numerical simulation. We present results that identify important aspects of two-phase flow behavior on different space and time scales which are relevant to nuclear waste disposal in both unsaturated and saturated formations.

20935 (LBL–35191) **Estimating two-phase hydraulic properties by inverse modeling.** Finsterle, S.; Pruess, K. Lawrence Berkeley Lab., CA (United States). Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States);Swiss National Cooperative for the Storage of Nuclear Waste, Baden (Switzerland). DOE Contract AC03-76SF00098. (CONF-940553–49: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94011351. Source: OSTI; NTIS; INIS; GPO Dep.

Disposal of high-level nuclear waste in geologic formations requires characterizing the hydrogeologic conditions at the potential site. This involves extensive data interpretation from laboratory and field experiments which are being performed on different scales. Two-phase flow processes are relevant if the potential site is located in the unsaturated zone, but they are also studied for repositories beneath the water table if the waste packages generate significant amounts of free gas. Numerical models are used for predicting the system behavior under different hydrologic and thermal loads. Parameters appearing in the governing equations are usually difficult to measure and subject to systematic errors. The strategy chosen to obtain model-related formation parameters is to calibrate the numerical model using observations of the system response. The practical relevance of parameter estimation for site characterization and design of field and laboratory experiments motivated the development. The purpose of this paper is to present the concept of parameter estimation, and to demonstrate the use of the proposed method for the interpretation of hydraulic tests conducted under two-phase flow conditions.

20936 (LBL-PUB–3092-Rev.2) **Guidelines for generators of hazardous chemical waste at LBL and guidelines for generators of radioactive and mixed waste at LBL: Revision 2.** Lawrence Berkeley Lab., CA (United States). Oct 1993. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94005326. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this document is to provide the acceptance criteria for the transfer of hazardous chemical waste to LBL's Hazardous Waste Handling Facility (HWHF). Hazardous chemical waste is a necessary byproduct of LBL's research and technical support activities. This waste must be handled properly if LBL is to operate safely and provide adequate protection to staff and the environment. These guidelines describe how you, as a generator of hazardous chemical waste, can meet LBL's acceptance criteria for hazardous chemical waste.

20937 (NUREG/CR–5229-Vol.6) **Field lysimeter investigations: Low-level waste data base development program for fiscal year 1993: Annual report: Volume 6.** McConnell, J.W. Jr. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Rogers,

R.D.; Jastrow, J.D.; Sanford, W.E.; Sullivan, T.M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1994. 51p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2577-Vol.6). Source: OSTI; NTIS; INIS; GPO.

The March 28, 1979 accident at Three Mile Island Unit 2 released approximately 560,000 gal of contaminated water to the auxiliary and fuel handling buildings. The water was decontaminated using a three-stage demineralization system called EPICOR-II containing organic and inorganic ion-exchange media. The first stage of the system was designated the prefilter, and the second and third stages were called demineralizers. Research is being conducted at the Idaho National Engineering Laboratory on materials from four of those EPICOR-II prefilters. The Field Lysimeter Investigations: Low-Level Waste Data Base Development Program, funded by the U.S. Nuclear Regulatory Commission, is (a) studying the degradation effects in EPICOR-II organic ion-exchange resins caused by radiation, (b) examining the adequacy of test procedures recommended in the Branch Technical Position on Waste Form to meet the requirements of 10 CFR 61 using solidified EPICOR-II resins, (c) obtaining performance information on solidified EPICOR-II ion-exchange resins in a disposal environment, and (d) determining the condition of EPICOR-II liners. Results of the eighth year of data acquisition from the field testing are presented and discussed. During the continuing field testing, both Portland type I–II cement and Dow vinyl ester-styrene waste forms are being tested in lysimeter arrays located at Argonne National Laboratory-East in Illinois and at Oak Ridge National Laboratory. The study is designed to provide continuous data on nuclide release and movement, as well as environment conditions, over a 20-year period. 24 references, 43 figures, 12 tables.

20938 (NUREG/CR–6114-Vol.3) **Performance assessment of a hypothetical low-level waste facility: Groundwater flow and transport simulation: Volume 3.** Talbott, M.E. (Massachusetts Inst. of Tech., Cambridge, MA (United States). Ralph M. Parsons Lab.); Gelhar, L.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Massachusetts Inst. of Tech., Cambridge, MA (United States). Ralph M. Parsons Lab. May 1994. 69p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Stochastic subsurface hydrologic theory is applied to data for a hypothetical low-level radioactive waste site to demonstrate the features of the hydraulic parameter estimation process, as developed by Gelhar and others. Effective values of hydraulic conductivity, macrodispersivity, and macrodispersivity enhancement are estimated from the data in this manner. A two-dimensional saturated flow and transport finite-element computer code is used to model the site. Four different isotope inputs and two types of input configurations contribute to an evaluation of model sensitivities. These sensitivities of the mean concentrations and the uncertainties around the mean are explored using an analytical model as an example. Results indicate that the spatial heterogeneity of isotope sorption, through its contribution to longitudinal dispersivity enhancement, has a large effect on the magnitude of concentration predictions, especially for isotopes with short half-lives in comparison to their retarded mean travel times. This observation emphasizes the need for accurate site data measurements that compliment the parameter estimation process. A comparison of simplified analytical screening models with the numerical model predictions shows that the analytical models tend to underestimate concentration levels at low times, potentially as a result of oversimplification of the flow field. Future models could address aspects that are neglected in this report, such as three-dimensionality or unsaturated flow and transport.

20939 (NUREG/CR–6164) **Release of radionuclides and chelating agents from cement-solidified decontamination low-level radioactive waste collected from the Peach Bottom Atomic Power Station Unit 3.** Akers, D.W. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Kraft, N.C.; Mandler, J.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1994. 129p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. Source: OSTI; NTIS; INIS.

As part of a study being performed for the Nuclear Regulatory Commission (NRC), small-scale waste-form specimens were collected during a low oxidation-state transition-metal ion (LOMI)-nitric permanganate (NP)-LOMI solidification performed in October 1989 at the Peach Bottom Atomic Power Station Unit 3. The purpose of this program was to evaluate the performance of cement-solidified decontamination waste to meet the low-level waste stability requirements defined in the NRC's "Technical Position on Waste Form," Revision 1. The samples were acquired and tested because little data have been obtained on the physical stability of actual cement-solidified decontamination ion-exchange resin waste forms and on the leachability of radionuclides and chelating agents from those waste forms. The Peach Bottom waste-form specimens were subjected to compressive strength, immersion, and leach testing in accordance with the NRC's "Technical Position on Waste Form," Revision 1. Results of this study indicate that the specimens withstood the compression tests (>500 psi) before and after immersion testing and leaching, and that the leachability indexes for all radionuclides, including ^{14}C, $^{99}T_c$, and ^{129}I, are well above the leachability index requirement of 6.0, required by the NRC's "Technical Position on Waste Form," Revision 1.

20940 (NUREG/CR–6188-Vol.1) **Microbial degradation of low-level radioactive waste: Volume 1, Annual report for FY 1993.** Rogers, R.D.; Hamilton, M.A.; Veeh, R.H.; McConnell, J.W. Jr. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1994. 52p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2730-Vol.1). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission stipulates that disposed low-level radioactive waste (LLW) be stabilized. Because of apparent ease of use and normal structural integrity, cement has been widely used as a binder to solidify LLW. However, the resulting waste forms are sometimes susceptible to failure due to the actions of waste constituents, stress, and environment. This report reviews laboratory efforts that are being developed to address the effects of microbiologically influenced chemical attack on cement-solidified LLW. Groups of microorganisms are being employed that are capable of metabolically converting organic and inorganic substrates into organic and mineral acids. Such acids aggressively react with cement and can ultimately lead to structural failure. Results on the application of mechanisms inherent in microbially influenced degradation of cement-based material are the focus of this report. Sufficient data-validated evidence of the potential for microbially influenced deterioration of cement-solidified LLW has been developed during the course of this study. These data support the continued development of appropriate tests necessary to determine the resistance of cement-solidified LLW to microbially induced degradation that could impact the stability of the waste form. They also justify the continued effort of enumeration of the conditions necessary to support the microbiological growth and population expansion.

20941 (ORNL/ER/Sub–87-99053/70) **Site Characterization Plan for the Old Hydrofracture Facility at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States); Bechtel National, Inc., Oak Ridge, TN (United States). Jan 1994. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94009179. Source: OSTI; NTIS; INIS; GPO Dep.

The aboveground structures of the Old Hydrofracture Facility (OHF) at Oak Ridge National Laboratory (ORNL) are scheduled for decontamination and decommissioning (D&D). This Site Characterization Plan presents the strategy and techniques to be used to characterize the OHF D&D structures in support of D&D planning, design, and implementation. OHF is located approximately 1 mile southwest of the main ORNL complex. From 1964 to 1979, OHF was used in the development and full-scale application of hydrofracture operations in which 969,000 gal of liquid low-level waste (LLLW) was mixed with grout and then injected under high

pressure into a low-permeability shale formation approximately 1/6 mile underground.

20942 (ORNL/GWPO–001) **Martin Marietta Energy Systems, Inc., Groundwater Program Management Plan.** Early, T.O. Oak Ridge National Lab., TN (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012356. Source: OSTI; NTIS; INIS; GPO Dep.

ESD Publication No. 4284.

The purpose of the Martin Marietta Energy Systems, Inc., (Energy Systems) Groundwater Program Management Plan is to define the function, organizational structure (including associated matrix organizations), interfaces, roles and responsibilities, authority, and relationship to the Department of Energy for the Energy Systems Groundwater Program Office (GWPO). GWPO is charged with the responsibility of coordinating all components of the groundwater program for Energy Systems. This mandate includes activities at the three Oak Ridge facilities [Oak Ridge National Laboratory, the Oak Ridge Y-12 Plant, and the Oak Ridge K-25 Site], as well as the Paducah and Portsmouth Gaseous Diffusion Plants.

20943 (ORNL/TM–12657) **Evaluation of sulfur polymer cement as a waste form for the immobilization of low-level radioactive or mixed waste.** Mattus, C.H.; Mattus, A.J. Oak Ridge National Lab., TN (United States). Mar 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94008748. Source: OSTI; NTIS; INIS; GPO Dep.

Sulfur polymer cement (SPC), also called modified sulphur cements, is a relatively new material in the waste immobilization field, although it was developed in the late seventies by the Bureau of Mines. The physical and chemical properties of SPC are interesting (e.g., development of high mechanical strength in a short time and high resistance to many corrosive environments). Because of its very low permeability and porosity, SPC is especially impervious to water, which, in turn, has led to its consideration for immobilization of hazardous or radioactive waste. Because it is a thermosetting process, the waste is encapsulated by the sulfur matrix; therefore, very little interaction occurs between the waste species and the sulfur (as there can be when waste prevents the set of portland cement-based waste forms).

20944 (ORNL/TM–12679) **Development and demonstration of treatment technologies for the processing of US Department of Energy Mixed Waste.** Bloom, G.A.; Berry, J.B. Oak Ridge National Lab., TN (United States). Jan 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94007408. Source: OSTI; NTIS; INIS; GPO Dep.

Mixed waste is defined as "waste contaminated with chemically hazardous and radioactive species." The Mixed Waste Integrated Program (MWIP) was established in response to the need for a unified, DOE complexwide solution to issues of mixed waste treatment that meets regulatory requirements. MWIP is developing treatment technologies that reduce risk, minimize life-cycle cost, and improve process performance as compared to existing technologies. Treatment for waste streams for which no current technology exists, and suitable waste forms for disposal, will be provided to improve operations of the DOE Office of Waste Management. MWIP is composed of six technical areas within a mixed-waste treatment system: (1) systems analysis, (2) materials handling, (3) chemical/physical separation, (4) waste destruction and stabilization, (5) off-gas treatment, and (6) final waste form stabilization. The status of the technical initiatives and the current research, development, and demonstration in each of these areas are described in this paper.

20945 (ORNL/TM–12714) **Feasibility study and concepts for use of compact process units to treat Hanford tank wastes.** Collins, E.D.; Bond, W.D.; Campbell, D.O.; Harrington, F.E.; Malkemus, D.W.; Peishel, F.L.; Yarbro, O.O. Oak Ridge National Lab., TN (United States). Jun 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013196. Source: OSTI; NTIS; INIS; GPO Dep.

A team of experienced radiochemical design engineers and chemists was assembled at Oak Ridge National Laboratory (ORNL) at the request of the Underground Storage Tank Integrated Demonstration (USTID) Program to evaluate the feasibility and perform a conceptual study of options for the use of compact processing units (CPUs), located at the Hanford, Washington, waste tank sites, to accomplish extensive pretreatment of the tank wastes using the clean-option concept. The scope of the ORNL study included an evaluation of the constraints of the various chemical process operations that may be employed and the constraints of necessary supporting operations. The latter include equipment maintenance and replacement, process control methods, product and by-product storage, and waste disposal.

20946 **Vitrification of waste.** Wicks, G.G. To Dept. of Energy. 1992. Filed date 1 Apr 1992. U.S. Patent Application 7-866,780. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94010157. Source: OSTI; NTIS; INIS; GPO Dep.

A method for encapsulating and immobilizing waste for disposal. Waste, preferably, biologically, chemically and radioactively hazardous, and especially electronic wastes, such as circuit boards, are placed in a crucible and heated by microwaves to a temperature in the range of approximately 300°C to 800°C to incinerate organic materials, then heated further to a temperature in the range of approximately 1100°C to 1400°C at which temperature glass formers present in the waste will cause it to vitrify. Glass formers, such as borosilicate glass, quartz or fiberglass can be added at the start of the process to increase the silicate concentration sufficiently for vitrification.

20947 (PNL–8845) **Minutes of the Tank Waste Science Panel meeting January 12–13, 1993.** Strachan, D.M. (comp.) (Pacific Northwest Lab., Richland, WA (United States)); Schulz, W.W. (comp.). Pacific Northwest Lab., Richland, WA (United States). Oct 1993. 378p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94005297. Source: OSTI; NTIS; INIS; GPO Dep.

The eight meeting of the Tank Waste Science Panel (Science Panel) was convened January 12, 1993 in Richland, Washington. A list of attendees at this meeting is provided in Appendix A. Appendix B is the agenda prepared for the meeting. It was not strictly followed. The meeting focused on the presentation and discussion of recent information and results obtained from studies conducted to understand flammable gas released and ferrocyanide content behavior in Hanford waste tanks. The Science Panel discussed work performed at Pacific Northwest Laboratoy PNL, Westinghouse Hanford Company, Florida State University, and Fauske Associates. A number of recommendations and observations were made.

20948 (PNL–8887) **Ferrocyanide safety program cyanide speciation studies FY 1993 annual report.** Bryan, S.A.; Pool, K.H.; Bryan, S.L.; Sell, R.L.; Thomas, L.M.P. Pacific Northwest Lab., Richland, WA (United States). Sep 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94009007. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes Pacific Northwest Laboratory's (PNL) FY 1993 progress toward developing and implementing methods to identify and quantify cyanide species in ferrocyanide tank waste. Currently, there are 24 high-level waste storage tanks at the US Department of Energy's (DOE) Hanford Site that have been placed on a Ferrocyanide Tank Watchlist because they contain an estimated 1000 g-moles or more of precipitated ferrocyanide. This amount of ferrocyanide is of concern because the consequences of a potential explosion may exceed those reported previously in safety analyses. To bound the safety concern, methods are needed to definitively measure and quantitate the amount of ferrocyanides present within actual waste tanks to a lower limit of at least 0.1 wt % up to approximately 15 wt %. The target analyte concentration for cyanide in waste is approximately 0.1 to 15 wt % (as CN) in the original undiluted sample. After dissolution of the original sample and appropriate dilutions, the concentration range of interest in the analytical solutions can vary between 0.001 to 0.1 wt % (as CN).

20949 (PNL–8902) **In Situ Remediation Integrated Program, Evaluation and assessment of containment technology.** Gerber, M.A.; Fayer, M.J. Pacific Northwest Lab., Richland, WA

(United States). Apr 1994. 100p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011438. Source: OSTI; NTIS; INIS; GPO Dep.

The In Situ Remediation Integrated Program (ISRIP) was established by the US Department of Energy (DOE) to advance the state-of-the art of innovative in situ remediation technologies to the point of demonstration and to broaden the applicability of these technologies to the widely varying site remediation requirements throughout the DOE complex. This program complements similar ongoing integrated demonstration programs being conducted at several DOE sites. The ISRIP has been conducting baseline assessments on in situ technologies to support program planning. Pacific Northwest Laboratory conducted an assessment and evaluation of subsurface containment barrier technology in support of ISRIP's Containment Technology Subprogram. This report summarizes the results of that activity and provides a recommendation for priortizing areas in which additional research and development is needed to advance the technology to the point of demonstration in support of DOE's site restoration activities.

20950 (PNL–8992) **Characterization of Analytical Reference Glass-1 (ARG-1).** Smith, G.L. Pacific Northwest Lab., Richland, WA (United States). Dec 1993. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94005296. Source: OSTI; NTIS; INIS; GPO Dep.

High-level radioactive waste may be immobilized in borosilicate glass at the West Valley Demonstration Project, West Valley, New York, the Defense Waste Processing Facility (DWPF), Aiken, South Carolina, and the Hanford Waste Vitrification Project (HWVP), Richland, Washington. The vitrified waste form will be stored in stainless steel canisters before its eventual transfer to a geologic repository for long-term disposal. Waste Acceptance Product Specifications (WAPS) (DOE 1993), Section 1.1.2 requires that the waste form producers must report the measured chemical composition of the vitrified waste in their production records before disposal. Chemical analysis of glass waste forms is receiving increased attention due to qualification requirements of vitrified waste forms. The Pacific Northwest Laboratory (PNL) has been supporting the glass producers' analytical laboratories by a continuing program of multilaboratory analytical testing using interlaboratory "round robin" methods. At the PNL Materials Characterization Center Analytical Round Robin 4 workshop "Analysis of Nuclear Waste Glass and Related Materials," January 16–17, 1990, Pleasanton, California, the meeting attendees decided that simulated nuclear waste analytical reference glasses were needed for use as analytical standards. Use of common standard analytical reference materials would allow the glass producers' analytical laboratories to calibrate procedures and instrumentation, to control laboratory performance and conduct self-appraisals, and to help qualify their various waste forms.

20951 (PNL–8998) **Experimental logistics plan in support of Extensive Separations for Hanford tank waste remediation systems.** Enderlin, W.I.; Swanson, J.L.; Carlson, C.D.; Hirschi, E.J. Pacific Northwest Lab., Richland, WA (United States). Dec 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006110. Source: OSTI; NTIS; INIS; GPO Dep.

All proposed methods for remediating the radioactive and chemical waste stored in single- and double-shell tanks (SSTs and DSTs) at the Hanford Site require the separation of the waste mixtures in the tank into high-level and low-level fractions, the safe transport of this separated waste to appropriate immobilization facilities, and the long-term disposal of the immobilized waste forms. Extensive experimentation, especially in waste separations, will be required to develop the technologies and to produce the data that support the most effective and safe cleanup processes. As part of this effort, Pacific Northwest Laboratory (PNL) is developing this detailed experimental logistics plan to determine the logistical/resource requirements, and ultimately the critical paths, necessary to effectively and safely conduct the multitude of experiments within the Extensive Separations Development Program, which addresses the experimental needs of a concept that provides a high degree of separation for the high-level and low-level waste fractions. The logistics issues developed for this program are expected to be similar to those for other programs aimed at remediating and disposing of the wastes.

20952 (PNL–9336) **Hanford Permanent Isolation Barrier Program: Asphalt technology test plan.** Freeman, H.D.; Romine, R.A. Pacific Northwest Lab., Richland, WA (United States). May 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013454. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Permanent Isolation Barriers use engineered layers of natural materials to create an integrated structure with backup protective features. The objective of current designs is to develop a maintenance-free permanent barrier that isolates wastes for a minimum of 1000 years by limiting water drainage to near-zero amounts. Asphalt is being used as an impermeable water diversion layer to provide a redundant layer within the overall barrier design. Data on asphalt barrier properties in a buried environment are not available for the required 100-year time frame. The purpose of this test plan is to outline the activities planned to obtain data with which to estimate performance of the asphalt layers.

20953 (PNL–9339) **Selective separation of Eu^{3+} using polymer-enhanced ultrafiltration.** Norton, M.V. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013564. Source: OSTI; NTIS; INIS; GPO Dep.

A process to selectively remove ^{241}Am from liquid radioactive waste was investigated as an actinide separation method applicable to Hanford and other waste sites. The experimental procedures involved removal of Eu, a nonradioactive surrogate for Am, from aqueous solutions at pH 5 using organic polymers in conjunction with ultrafiltration. Commercially available polyacrylic acid (60,000 MW) and Pacific Northwest Laboratory's (PNL) synthesized E3 copolymer (~10,000 MW) were tested. Test solutions containing 10 μg/mL of Eu were dosed vath each polymer at various concentrations in order to bind Eu (i.e., by complexation and/or cation exchange) for subsequent rejection by an ultrafiltration coupon. Test solutions were filtered with and without polymer to determine if enhanced Eu separation could be achieved from polymer treatment. Both polymers significantly increased Eu removal. Optimum concentrations were 20 μg/mL of polyacrylic acid and 100 μg/mL of E3 for 100% Eu rejection by the Amicon PM10 membrane at 55 psi. In addition to enhancement of removal, the polymers selectively bound Eu over Na, suggesting that selective separation of Eu was possible. This suggests that polymer-enhanced ultrafiltration is a potential process for separation of ^{241}Am from Hanford tank waste, further investigation of binding agents and membranes effective under very alkaline and high ionic strength is warranted. This process also has potential applications for selective separation of toxic metals from industrial process streams.

20954 (PNL–9414) **Global ice sheet modeling.** Hughes, T.J. (Univ. of Maine, Orono, ME (United States). Institute for Quaternary Studies); Fastook, J.L. Pacific Northwest Lab., Richland, WA (United States). May 1994. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013744. Source: OSTI; NTIS; INIS; GPO Dep.

The University of Maine conducted this study for Pacific Northwest Laboratory (PNL) as part of a global climate modeling task for site characterization of the potential nuclear waste respository site at Yucca Mountain, NV. The purpose of the study was to develop a global ice sheet dynamics model that will forecast the three-dimensional configuration of global ice sheets for specific climate change scenarios. The objective of the third (final) year of the work was to produce ice sheet data for glaciation scenarios covering the next 100,000 years. This was accomplished using both the map-plane and flowband solutions of our time-dependent, finite-element gridpoint model. The theory and equations used to develop the ice sheet models are presented. Three future scenarios were simulated by the model and results are discussed.

20955 (PNL–9418) **Global climate change model natural climate variation: Paleoclimate data base, probabilities and astronomic predictors.** Kukla, G. (Columbia Univ., Palisades, NY (United States). Lamont-Doherty Geological Observatory); Gavin, J.

Pacific Northwest Lab., Richland, WA (United States); Columbia Univ., Palisades, NY (United States). Lamont-Doherty Geological Observatory. May 1994. 592p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013956. Source: OSTI; NTIS; INIS; GPO Dep.

This report was prepared at the Lamont-Doherty Geological Observatory of Columbia University at Palisades, New York, under subcontract to Pacific Northwest Laboratory it is a part of a larger project of global climate studies which supports site characterization work required for the selection of a potential high-level nuclear waste repository and forms part of the Performance Assessment Scientific Support (PASS) Program at PNL. The work under the PASS Program is currently focusing on the proposed site at Yucca Mountain, Nevada, and is under the overall direction of the Yucca Mountain Project Office US Department of Energy, Las Vegas, Nevada. The final results of the PNL project will provide input to global atmospheric models designed to test specific climate scenarios which will be used in the site specific modeling work of others. The primary purpose of the data bases compiled and of the astronomic predictive models is to aid in the estimation of the probabilities of future climate states. The results will be used by two other teams working on the global climate study under contract to PNL. They are located at and the University of Maine in Orono, Maine, and the Applied Research Corporation in College Station, Texas. This report presents the results of the third year's work on the global climate change models and the data bases describing past climates.

20956 (PNL–9419) **Thermophysical properties of Hanford high-level tank wastes: A preliminary survey of recent data.** Willingham, C.E. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94009635. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents an analysis performed by Pacific Northwest Laboratory (PNL) involving thermophysical properties of Hanford high-level tank wastes. PNL has gathered and summarized the available information on density, viscosity, thermal conductivity, heat capacity, particle size, shear strength, and heat generation. The information was compiled from documented characterization reports of Hanford single-shell and double-shell tanks. The report summarizes the thermophysical properties of the various waste materials, the anticipated range for the various waste forms, and estimates of the variability of the measured data. The thermophysical information compiled in this study is useful as input to sensitivity and parametric studies for the Multi-Function Waste Tank Facility Project. Information from only 33 of the 177 high-level waste storage tanks was compiled. Density data are well characterized for the tanks selected in this study. It was found that the reported viscosity of the wastes varies widely and that a single value should not be used to represent viscosity for all waste. Significant variations in reported shear strength and heat generation values were also found. Very few of the tank characterization reports described information on waste heat capacity. In addition, there was no supernatant vapor pressure information reported in the waste characterization reports examined in this study. Although thermal conductivity measurements were made for a number of tanks, most of the measurements were made in 1975. Finally, particle size distribution measurements of waste in 20 tanks were compiled. The analyst must be cognizant of differences between the number and volume distributions reported for particle size.

20957 (PNL–9426) **Preliminary survey of separations technology applicable to the pretreatment of Hanford tank waste (1992–1993).** Lawrence, W.E.; Kurath, D.E. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011404. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy has established the Tank Waste Remediation System (TWRS) to manage and dispose of radioactive wastes stored at the Hanford Site. Within this program are evaluations of pretreatment system alternatives through literature reviews. The information in this report was collected as part of this project at Pacific Northwest Laboratory. A preliminary survey of literature on separations recently entered into the Hanford electronic databases (1992–1993) that have the potential for pretreatment of Hanford tank waste was conducted. Separation processes that can assist in the removal of actinides (uranium, plutonium, americium), lanthanides, barium, ^{137}Cs, ^{90}Sr,^{129}I, ^{63}Ni, and ^{99}Tc were evaluated. Separation processes of interest were identified through literature searches, journal reviews, and participation in separation technology conferences. This report contains brief descriptions of the potential separation processes, the extent and/or selectivity of the separation, the experimental conditions, and observations. Information was collected on both national and international separation studies to provide a global perspective on recent research efforts.

20958 (PNL–9428) **Research-scale melter test report.** Cooper, M.F.; Elliott, M.L.; Eyler, L.L.; Freeman, C.J.; Higginson, J.J.; Mahoney, L.A.; Powell, M.R. Battelle Pacific Northwest Lab., Richland, WA (United States). May 1994. 301p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012136. Source: OSTI; NTIS; INIS; GPO Dep.

The Melter Performance Assessment (MPA) activity in the Pacific Northwest Laboratory's (PNL) Hanford Waste Vitrification Plant (HWVP) Technology Development (PHTD) effort is intended to determine the impact of noble metals on the operational life of the reference HWVP melter. As a part of this activity, a parametric melter test was completed using a Research-Scale Melter (RSM). The RSM is a small, approximately 1/100-scale melter, 6-in.-diameter, that allows rapid changing of process conditions and subsequent re-establishment of a steady-state condition. The test matrix contained nine different segments that varied the melter operating parameters (glass and plenum temperatures) and feed properties (oxide concentration, redox potential, and noble metal concentrations) so that the effects of these parameters on noble metal agglomeration on the melter floor could be evaluated. The RSM operated for 48 days and consumed 1,300 L of feed, equating to 153 tank turnovers. The run produced 531 kg of glass. During the latter portion of the run, the resistance between the electrodes decreased. Upon destructive examination of the melter, a layer of noble metals was found on the bottom. This was surprising because the glass residence time in the RSM is only 10% of the HWVP plant melter. The noble metals layer impacted the melter significantly. Approximately 1/3 of one paddle electrode was melted or corroded off. The cause is assumed to be localized heating from short circuiting of the electrode to the noble metal layer. The metal layer also removed approximately 1/2 in. of the refractory on the bottom of the melter. The mechanism for this damage is not presently known.

20959 (PNL–9459) **Status and integration of the gas generation studies performed for the Hydrogen Safety Program: FY 1993, Annual report.** Strachan, D.M. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011405. Source: OSTI; NTIS; INIS; GPO Dep.

This document represents the second in a series of documents in which information is summarized and integrated on the chemical mechanisms for gas generation from simulated wastes that mimic the nuclear waste in Tank 241-SY. Over the past year the reliability of the instrumentation that has been installed on Tank 101-SY has been increased dramatically. Gases composed of H_2, N_2O, N_2, and NH_3 are continuously released at low levels and also periodically released from the waste stored in this tank such that the lower flammability limit of 4% H_2 is sometimes exceeded. To better understand the reasons for this phenomenon and with the goal of mitigating the potential safety problem associated with the flammability, instrumentation has been installed on the tank and studies have been carried out to understand the mechanism by which these gases are generated. It is worthwhile to annually summarize this information in a single document, to integrate the information, and to highlight the remaining open questions surrounding the mechanism of gas generation. This is the goal of this document. Information on simulated wastes under thermal and radiation conditions has been collected from work performed at Argonne National Laboratory, Georgia Institute of Technology, and Pacific Northwest Laboratory;

this report attempts to correlate the simulated data with that of actual tank waste. This document is lengthier than the former report because so much more information was available this year.

20960 (PNL–9747) **Pretreatment of neutralized cladding removal waste sludge: Results of the second design basis experiment.** Lumetta, G.J. Pacific Northwest Lab., Richland, WA (United States). May 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012775. Source: OSTI; NTIS; GPO Dep.

For several years, the Pacific Northwest Laboratory (PNL) has been investigating methods to pretreat Hanford neutralized cladding removal waste (NCRW) sludge. In the past, Zircaloy-clad metallic U fuel was chemically decladded using the Zirflex process; NCRW sludge was formed when the decladding solution was neutralized for storage in carbon-steel tanks. This sludge, which is currently stored in Tanks 103-AW and 105-AW on the Hanford Site, primarily consists of insoluble Zr hydroxides and/or oxides and NaF. Significant quantities of Al, La, U, as well as other insoluble minor constituents are present in the sludge, along with sodium and potassium nitrates, nitrites, and hydroxides in the interstitial liquid. The sludge contains about 2,000 nCi of transuranic (TRU) material per gram of dry sludge, and mixed fission products. Therefore, the sludge must be handled as high-level waste (HLW). The NCRW sludge must be pretreated before treatment (e.g., vitrification) and disposal, so that the overall cost of disposal can be minimized. The NCRW pretreatment flowsheet was designed to achieve the following objectives: (a) to separate Am and Pu from the major sludge constituents (Na, Zr). (b) to separate Am and Pu from U. (c) to concentrate Am and Pu in a small volume for immobilization in borosilicate glass, based on Hanford Waste Vitrification Plant (HWVP). The flowsheet involves: (1) sludge washing, (2) sludge dissolution, (3) extraction of U with tributyl phosphate (TBP), and (4) extraction of TRUs with octyl(phenyl)-N,N-diisobutylcarbamoylmethyl-phosphine oxide (CMPO). As presented in the flowsheet, the NCRW sludge is first washed with 0.I M NaOH to remove interstitial liquid and soluble salts from the sludge including sodium and potassium fluorides, carbonates, hydroxides, nitrates, and nitrites. The washed sludge is then subjected to two dissolution steps to achieve near complete dissolution of Zr.

20961 (PNL–9784) **Solid Waste Forecast Database: User's guide (Version 1.5).** Bierschbach, M.C. Pacific Northwest Lab., Richland, WA (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013005. Source: OSTI; NTIS; GPO Dep.

The Solid Waste Forecast Database (SWFD) system is an analytical tool developed by Pacific Northwest Laboratory (PNL) for Westinghouse Hanford Company (WHC) specifically to address Hanford solid waste management issues. This document is one of a set of documents supporting the SWFD system and providing instructions in the use and maintenance of SWFD components. This manual contains instructions for using Version 1.5 of the SWFD, including system requirements and preparation, entering and maintaining data, and performing routine database functions. This document supports only those operations that are specific to SWFD menus and functions and does not provide instruction in the use of Paradox, the database management system in which the SWFD is established.

20962 (PNL–9789) **Contamination surveys for release of material.** Durham, J.S. (Pacific Northwest Lab., Richland, WA (United States)); Johnson, M.L.; Gardner, D.L. Pacific Northwest Lab., Richland, WA (United States). May 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013671. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes, and presents the technical basis for, a methodology for performing instrument surveys to release material from radiological control, including release to controlled areas and release from radiological control. The methodology is based on a fast scan survey, a large-area wipe survey, and a series of statistical, fixed measurements. The methodology meets the requirements of the US Department of Energy Radiological Control Manual (RadCon Manual) (DOE 1994) and DOE Order 5400.5 (DOE 1990) for release of material in less time than is required by a conventional scan survey. Implementation of the proposed methodology with a confidence interval of 67% will meet the material release requirements. The material evaluation process will allow material that has not been exposed to contamination to be released from radiological control without a survey. For potential radioactive contaminants that are not reserved in DOE Order 5400.5, the methodology will allow material to be released from radiological control. For other radionuclides, with the exception of some difficult-to-detect radionuclides, material may be released for controlled use. Compared with current techniques, the proposed methodology will reduce the amount of time required to perform surveys.

20963 (PNL-SA–22330) **Effect of aluminate ions on the heat of hydration of cementitious waste forms.** Lokken, R.O. Pacific Northwest Lab., Richland, WA (United States). Nov 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-931168–1: 3. Pacific Rim forum on composite materials: low-cost high-volume composite materials, Honolulu, HI (United States), 7-10 Nov 1993). Order Number DE94004764. Source: OSTI; NTIS; INIS; GPO Dep.

During the hydration and setting of high-salt content liquid waste grouts, considerable heat is generated by exothermic reactions within the grout. These reactions include hydration reactions of cementitious solids and reactions between waste constituents and the solids. Adiabatic temperature rises exceeding 80°C have been estimated for grouts prepared with a dry blend of 47 wt % fly ash, 47 wt % blast furnace slag, and 6 wt % type I/II Portland cement (1) Performance criteria for grout disposal specify that the temperature of the grout waste form must not exceed 90°C (2) To counter the increase in temperature, inert solids were added to the "47/47/6" dry blend to reduce the amount of heat-generating solids, thereby decreasing the temperature rise. Based on preliminary results from adiabatic calorimetry, a dry blend consisting of 40 wt % limestone flour, 28 wt % class F fly ash, 28 wt % ground blast furnace slag, and 4 wt % type I/II Portland cement was selected for further testing.

20964 (PNL-SA–23742) **Vitrification development for sludge and ash mixed wastes.** Whittington, K.F. (Pacific Northwest Lab., Richland, WA (United States)); Peters, R.D.; Cooper, M.F.; Bonner, D.; Phares, D.; Perez, S. Pacific Northwest Lab., Richland, WA (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940225–108: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94012244. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary glass development was carried out on four surrogate wastes. The surrogate wastes evaluated were ash and sludge from Oak Ridge National Laboratory, sludge from Rocky Flats, and sludge from Los Alamos National Laboratory. The work involved numerous melting trails followed by visual homogeneity examination and short-duration leach testing on glass specimens. Melter testing on selected compositions was performed with a laboratory-scale joule-heated furnace. With proper formulations and melter operating parameters, these mixed wastes appear to be readily adaptable to available vitrification technology.

20965 (PNL-SA–23793) **Waste Tank Safety Screening Module: An aspect of Hanford Site tank waste characterization.** Hill, J.G. (Pacific Northwest Lab., Richland, WA (United States)); Wood, T.W.; Babad, H.; Redus, K.S. Pacific Northwest Lab., Richland, WA (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940225–107: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94012245. Source: OSTI; NTIS; INIS; GPO Dep.

Forty-five (45) of the 149 Hanford single-shell tanks have been designated as Watch-List tanks for one or more high-priority safety issues, which include significant concentrations of organic materials, ferrocyanide salts, potential generation of flammable gases, high heat generation, criticality, and noxious vapor generation. While limited waste characterization data have been acquired on these wastes under the original Tri-Party Agreement, to date all of the tank-by-tank assessments involved in these safety issue designations have been based on historical data rather than waste on

data. In response to guidance from the Defense Nuclear Facilities Safety Board (DNFSB finding 93-05) and related direction from the US Department of Energy (DOE), Westinghouse Hanford Company, assisted by Pacific Northwest Laboratory, designed a measurements-based screening program to screen all single-shell tanks for all of these issues. This program, designated the Tank Safety Screening Module (TSSM), consists of a regime of core, supernatant, and auger samples and associated analytical measurements intended to make first-order discriminations of the safety status on a tank-by-tank basis. The TSSM combines limited tank sampling and analysis with monitoring and tank history to provide an enhanced measurement-based categorization of the tanks relative to the safety issues. This program will be implemented beginning in fiscal year (FY) 1994 and supplemented by more detailed characterization studies designed to support safety issue resolution.

20966 (PNL-SA–24139) **Effects of Pd, Rh, and Ru concentration on HCOOH decomposition during the processing of NCAW waste simulant.** Patello, G.K.; Smith, H.D.; Wiemers, K.D.; Williford, R.E.; Bell, R.D.; Larson, D.E. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940416–11: 96. annual meeting of the American Ceramic Society, Indianapolis, IN (United States), 24-28 Apr 1994). Order Number DE94013324. Source: OSTI; NTIS; INIS; GPO Dep.

The noble metals Pd, Rh, and Ru that are present in the Hanford high-level waste will be processed into a melter feed for vitrification and permanent disposal. The treatment of waste slurry with HCOOH, a step in producing a melter feed, results in the production of H_2 and NH_3 due to the catalytic activity of the noble metals. The presence of H_2 and NH_3 could lead to hazardous conditions in a treatment facility. This study determined the relationship between noble metals concentration and H_2 and NH_3 production for application in future pilot-scale studies and prediction of catalytic activity for a waste with known noble metals concentration. Hydrogen production increased as noble metals concentration increased until a saturation level was reached. Ammonia production increased with noble metal concentration. Due to the limited number of tests, these relationships require confirmation.

20967 (RFP–4825) **Cementation and solidification of Rocky Flats Plant incinerator ash.** Phillips, J.A.; Semones, G.B. EG and G Rocky Flats, Inc., Golden, CO (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90RF62349. (CONF-9404126–2: Mixed waste thermal treatment symposium, Denver, CO (United States), 12-14 Apr 1994). Order Number DE94009963. Source: OSTI; NTIS; INIS; GPO Dep.

Cementation studies on various aqueous waste streams at Rocky Flats have shown this technology to be effective for immobilizing the RCRA constituents in the waste. Cementation is also being evaluated for encapsulation of incinerator ash. Experiments will initially evaluate a surrogate ash waste using a Taguchi experimental design to optimize the cement formulation and waste loading levels for this application. Variables of waste loading, fly ash additions, water/cement ratio, and cement type will be tested at three levels each during the course of this work. Tests will finally be conducted on actual waste using the optimized cement formulation developed from this testing. This progression of tests will evaluate the effectiveness of cement encapsulation for this waste stream without generating any additional wastes.

20968 (SAND–92-0449) **Fracture analysis and rock quality designation estimation for the Yucca Mountain Site Characterization Project: Yucca Mountain Site Characterization Project.** Lin, M. (Agapito (J.F.T.) and Associates, Inc., Grand Junction, CO (United States)); Hardy, M.P.; Bauer, S.J. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 127p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE94008700. Source: OSTI; NTIS; INIS; GPO Dep.

Within the Yucca Mountain Site Characterization Project, the design of drifts and ramps and evaluation of the impacts of thermomechanical loading of the host rock requires definition of the rock mass mechanical properties. Ramps and exploratory drifts will intersect both welded and nonwelded tuffs with varying abundance of fractures. The rock mass mechanical properties are dependent on the intact rock properties and the fracture joint characteristics. An understanding of the effects of fractures on the mechanical properties of the rock mass begins with a detailed description of the fracture spatial location and abundance, and includes a description of their physical characteristics. This report presents a description of the abundance, orientation, and physical characteristics of fractures and the Rock Quality Designation in the thermomechanical stratigraphic units at the Yucca Mountain site. Data was reviewed from existing sources and used to develop descriptions for each unit. The product of this report is a data set of the best available information on the fracture characteristics.

20969 (SAND–92-2127) **A comparison of geostatistically based inverse techniques for use in performance assessment analysis at the Waste Isolation Pilot Plant Site: Results from Test Case No. 1.** Zimmerman, D.A. (GRAM, Inc., Albuquerque, NM (United States)); Gallegos, D.P. Sandia National Labs., Albuquerque, NM (United States). Oct 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94008539. Source: OSTI; NTIS; INIS; GPO Dep.

The groundwater flow pathway in the Culebra Dolomite aquifer at the Waste Isolation Pilot Plant (WIPP) has been identified as a potentially important pathway for radionuclide migration to the accessible environment. Consequently, uncertainties in the models used to describe flow and transport in the Culebra need to be addressed. A "Geostatistics Test Problem" is being developed to evaluate a number of inverse techniques that may be used for flow calculations in the WIPP performance assessment (PA). The Test Problem is actually a series of test cases, each being developed as a highly complex synthetic data set; the intent is for the ensemble of these data sets to span the range of possible conceptual models of groundwater flow at the WIPP site. The Test Problem analysis approach is to use a comparison of the probabilistic groundwater travel time (GWTT) estimates produced by each technique as the basis for the evaluation. Participants are given observations of head and transmissivity (possibly including measurement error) or other information such as drawdowns from pumping wells, and are asked to develop stochastic models of groundwater flow for the synthetic system. Cumulative distribution functions (CDFs) of groundwater flow (computed via particle tracking) are constructed using the head and transmissivity data generated through the application of each technique; one semi-analytical method generates the CDFs of groundwater flow directly. This paper describes the results from Test Case No. 1.

20970 (SAND–92-2625) **A computational model for three-dimensional jointed media with a single joint set: Yucca Mountain Site Characterization Project.** Koteras, J.R. Sandia National Labs., Albuquerque, NM (United States). Feb 1994. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94007582. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes a three-dimensional model for jointed rock or other media with a single set of joints. The joint set consists of evenly spaced joint planes. The normal joint response is nonlinear elastic and is based on a rational polynomial. Joint shear stress is treated as being linear elastic in the shear stress versus slip displacement before attaining a critical stress level governed by a Mohr-Coulomb faction criterion. The three-dimensional model represents an extension of a two-dimensional, multi-joint model that has been in use for several years. Although most of the concepts in the two-dimensional model translate in a straightforward manner to three dimensions, the concept of slip on the joint planes becomes more complex in three dimensions. While slip in two dimensions can be treated as a scalar quantity, it must be treated as a vector in the joint plane in three dimensions. For the three-dimensional model proposed here, the slip direction is assumed to be the direction of maximum principal strain in the joint plane. Five test problems are presented to verify the correctness of the computational implementation of the model.

20971 (SAND–93-0055) **Modeling gas and brine migration for assessing compliance of the Waste Isolation Pilot Plant.** Vaughn, P. (Applied Physics, Inc., Albuquerque, NM (United States)); Butcher, B.; Helton, J.; Swift, P. Sandia National Labs., Albuquerque, NM (United States). Oct 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94008538. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the WIPP Project Integration Office (WPIO) of the DOE, the WIPP Performance Assessment (PA) Department of Sandia National Laboratories (SNL) has completed preliminary uncertainty and sensitivity analyses of gas and brine migration away from the undisturbed repository. This paper contains descriptions of the numerical model and simulations, including model geometries and parameter values, and a summary of major conclusions from sensitivity analyses. Because significant transport of contaminants can only occur in a fluid (gas or brine) medium, two-phase flow modeling can provide an estimate of the distance to which contaminants can migrate. Migration of gas or brine beyond the RCRA "disposal-unit boundary" or the Standard's accessible environment constitutes a potential, but not certain, violation and may require additional evaluations of contaminant concentrations.

20972 (SAND–93-2450C) **A formal expert judgment procedure for performance assessments of the Waste Isolation Pilot Plant.** Trauth, K.M. (Sandia National Labs., Albuquerque, NM (United States)); Guzowski, R.V.; Hora, S.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940553–6: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94006585. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Isolation Pilot Plant (WIPP) is an experimental facility located in southeastern New Mexico. It has been designed to determine the feasibility of the geologic disposal of defense-generated transuranic waste in a deep bedded-salt formation. The WIPP was also designed for disposal and will operate in that capacity if approved. The WIPP Performance Assessment Department at Sandia National Laboratories has been conducting analyses to assess the long-term performance of the WIPP. These analyses sometimes require the use of expert judgment. This Department has convened several expert-judgment panels and from that experience has developed an internal quality-assurance procedure to guide the formal elicitation of expert judgment. This protocol is based on the principles found in the decision-analysis literature.

20973 (SAND–93-2675) **Total-system performance assessment for Yucca Mountain – SNL second iteration (TSPA-1993): Executive summary.** Wilson, M.L. (Sandia National Labs., Albuquerque, NM (United States)); Barnard, R.W.; Gauthier, J.H. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012995. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories has completed the second iteration of the periodic total-system performance assessments (TSPA-93) for the Yucca Mountain Site Characterization Project (YMP). Scenarios describing expected conditions (aqueous and gaseous transport of contaminants) and low-probability events (human-intrusion drilling and volcanic intrusion) are modeled. The hydrologic processes modeled include estimates of the perturbations to ambient conditions caused by heating of the repository resulting from radioactive decay of the waste. TSPA-93 incorporates significant new detailed process modeling, including two- and three-dimensional modeling of thermal effects, groundwater flow in the saturated-zone aquifers, and gas flow in the unsaturated zone. Probabilistic analyses are performed for aqueous and gaseous flow and transport, human intrusion, and basaltic magmatic activity. Results of the calculations lead to a number of recommendations concerning studies related to site characterization. Primary among these are the recommendations to obtain better information on percolation flux at Yucca Mountain, on the presence or absence of flowing fractures, and on physical and chemical processes influencing gaseous flow. Near-field thermal and chemical processes, and waste-container degradation are also areas where additional investigations may reduce important uncertainties. Recommendations for repository and waste-package design studies are: (1) to evaluate the performance implications of large-size containers, and (2) to investigate in more detail the implications of high repository thermal power output on the adjacent host rock and on the spent fuel.

20974 (SAND–93-2675-Vol.1) **Total-system performance assessment for Yucca Mountain - SNL second iteration (TSPA-1993): Volume 1.** Wilson, M.L. (and others); Gauthier, J.H.; Barnard, R.W.; Barr, G.E.; Dockery, H.A.; Dunn, E.; Eaton, R.R.; Guerin, D.C.; Lu, N.; Martinez, M.J. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 338p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013818. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories has completed the second iteration of the periodic total-system performance assessments (TSPA-93) for the Yucca Mountain Site Characterization Project (YMP). These analyses estimate the future behavior of a potential repository for high-level nuclear waste at the Yucca Mountain, Nevada, site under consideration by the Department of Energy. TSPA-93 builds upon previous efforts by emphasizing YMP concerns relating to site characterization, design, and regulatory compliance. Scenarios describing expected conditions (aqueous and gaseous transport of contaminants) and low-probability events (human-intrusion drilling and volcanic intrusion) are modeled. The hydrologic processes modeled include estimates of the perturbations to ambient conditions caused by heating of the repository resulting from radioactive decay of the waste. Hydrologic parameters and parameter probability distributions have been derived from available site data. Possible future climate changes are modeled by considering two separate groundwater infiltration conditions: "wet" with a mean flux of 10 mm/yr, and "dry" with a mean flux of 0.5 mm/yr. Two alternative waste-package designs and two alternative repository areal thermal power densities are investigated. One waste package is a thin-wall container emplaced in a vertical borehole, and the second is a container designed with corrosion-resistant and corrosion-allowance walls emplaced horizontally in the drift. Thermal power loadings of 57 kW/acre (the loading specified in the original repository conceptual design) and 114 kW/acre (a loading chosen to investigate effects of a "hot repository") are considered. TSPA-93 incorporates significant new detailed process modeling, including two- and three-dimensional modeling of thermal effects, groundwater flow in the saturated-zone aquifers, and gas flow in the unsaturated zone.

20975 (SAND–93-2675-Vol.2) **Total-system performance assessment for Yucca Mountain - SNL second iteration (TSPA-1993): Volume 2.** Wilson, M.L. (Sandia National Labs., Albuquerque, NM (United States)); Barnard, R.W.; Barr, G.E.; Dockery, H.A.; Dunn, E.; Eaton, R.R.; Martinez, M.J.; Gauthier, J.H.; Guerin, D.C.; Lu, N. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 477p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013819. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories has completed the second iteration of the periodic total-system performance assessments (TSPA-93) for the Yucca Mountain Site Characterization Project (YMP). These analyses estimate the future behavior of a potential repository for high-level nuclear waste at the Yucca Mountain, Nevada, site under consideration by the Department of Energy. TSPA-93 builds upon previous efforts by emphasizing YMP concerns relating to site characterization, design, and regulatory compliance. Scenarios describing expected conditions (aqueous and gaseous transport of contaminants) and low-probability events (human-intrusion drilling and volcanic intrusion) are modeled. The hydrologic processes modeled include estimates of the perturbations to ambient conditions caused by heating of the repository resulting from radioactive decay of the waste. Hydrologic parameters and parameter probability distributions have been derived from available site data. Possible future climate changes are modeled by considering two separate groundwater infiltration conditions: "wet" with a mean flux of 10 mm/yr, and "dry" with a mean flux of 0.5 mm/yr. Two alternative waste-package designs and two alternative repository areal

thermal power densities are investigated. One waste package is a thin-wall container emplaced in a vertical borehole, and the second is a container designed with corrosion-resistant and corrosion-allowance walls emplaced horizontally in the drift. Thermal power loadings of 57 kW/acre (the loading specified in the original repository conceptual design) and 114 kW/acre (a loading chosen to investigate effects of a "hot repository") are considered. TSPA-93 incorporates significant new detailed process modeling, including two- and three-dimensional modeling of thermal effects, groundwater flow in the saturated-zone aquifers, and gas flow in the unsaturated zone.

20976 (SAND–93-2774C) **Wetting phase permeability in a partially saturated horizontal fracture.** Nicholl, M.J.; Glass, R.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940553–43: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94010384. Source: OSTI; NTIS; INIS; GPO Dep.

A major obstacle to understanding of unsaturated fracture flow is the paucity of physical data on both fracture aperture structure and the effects of phase structure on permeability. An experimental procedure is developed for collecting detailed data on aperture and phase structure from a transparent analog fracture. Stable phase structures of varying complexity are creating within the horizontal analog fracture. Wetting phase permeability is measured under steady-state conditions. A process based model for wetting phase relative permeability is explored. Average distribution of the wetting phase is shown to provide insufficient information for modeling relative permeability; descriptive models must account for spatial structure of the phases.

20977 (SAND–93-3903C) **Modeling infiltration into a tuff matrix from a saturated vertical fracture.** Ho, C.K. Sandia National Labs., Albuquerque, NM (United States). [1993]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940553–26: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94008953. Source: OSTI; NTIS; INIS; GPO Dep.

Saturation profiles resulting from TOUGH2 numerical simulations of water infiltration into a tuff matrix from a saturated vertical fracture have been compared to experimental results. The purpose was to determine the sensitivity of the infiltration on local heterogeneities and different representations of two-phase characteristic curves used by the model. Findings indicate that the use of simplified (linearized) capillary pressure curves with rigorous (van Genuchten) relative permeability curves resulted in a more computationally efficient solution without a loss in accuracy. However, linearized forms of the relative permeability functions produced poor results, regardless of the form of the capillary pressure function. In addition, numerical simulations revealed that the presence of local heterogeneities in the tuff caused non-uniform saturation distributions and wetting fronts in the in matrix.

20978 (SAND–93-4045C) **Studies of non-isothermal flow in saturated and partially saturated porous media.** Ho, C.K.; Maki, K.S.; Glass, R.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940553–44: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94010395. Source: OSTI; NTIS; INIS; GPO Dep.

Physical and numerical experiments have been performed to investigate the behavior of nonisothermal flow in two-dimensional saturated and partially saturated porous media. The physical experiments were performed to identify non-isothermal flow fields and temperature distributions in fully saturated, half-saturated, and residually saturated two-dimensional porous media with bottom heating and top cooling. Two counter-rotating liquid-phase convective cells were observed to develop in the saturated regions of all three cases. Gas-phase convection was also evidenced in the unsaturated regions of the partially saturated experiments. TOUGH2 numerical simulations of the saturated case were found to be strongly dependent on the assumed boundary conditions of the physical system. Models including heat losses through the boundaries of the test cell produced temperature and flow fields that were in better agreement with the observed temperature and flow fields than models that assumed insulated boundary conditions. A sensitivity analysis also showed that a reduction of the bulk permeability of the porous media in the numerical simulations depressed the effects of convection, flattening the temperature profiles across the test cell.

20979 (SAND–94-0185) **Modeling heterogeneous unsaturated porous media flow at Yucca Mountain.** Robey, T.H. (Spectra Research Inst., Albuquerque, NM (United States)). Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940553–18: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94008612. Source: OSTI; NTIS; INIS; GPO Dep.

Geologic systems are inherently heterogeneous and this heterogeneity can have a significant impact on unsaturated flow through porous media. Most previous efforts to model groundwater flow through Yucca Mountain have used stratigraphic units with homogeneous properties. However, modeling heterogeneous porous and fractured tuff in a more realistic manner requires numerical methods for generating heterogeneous simulations of the media, scaling of material properties from core scale to computational scale, and flow modeling that allows channeling. The Yucca Mountain test case of the INTRAVAL project is used to test the numerical approaches. Geostatistics is used to generate more realistic representations of the stratigraphic units and heterogeneity within units is generated using sampling from property distributions. Scaling problems are reduced using an adaptive grid that minimizes heterogeneity within each flow element. A flow code based on the dual mixed-finite-element method that allows for heterogeneity and channeling is employed. In the Yucca Mountain test case, the simulated volumetric water contents matched the measured values at drill hole USW UZ-16 except in the nonwelded portion of Prow Pass.

20980 (SAND–94-0982C) **The mixed waste landfill integrated demonstration.** Burford, T.D.; Williams, C.V. Sandia National Labs., Albuquerque, NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940499–8: Federal environmental restoration and waste minimization conference and exhibition, New Orleans, LA (United States), 25-29 Apr 1994). Order Number DE94010799. Source: OSTI; NTIS; INIS; GPO Dep.

The Mixed Waste Landfill Integrated Demonstration (MWLID) focuses on "in-situ" characterization, monitoring, remediation, and containment of landfills in arid environments that contain hazardous and mixed waste. The MWLID mission is to assess, demonstrate, and transfer technologies and systems that lead to faster, better, cheaper, and safer cleanup. Most important, the demonstrated technologies will be evaluated against the baseline of conventional technologies and systems. The comparison will include the cost, efficiency, risk, and feasibility of using these innovative technologies at other sites.

20981 (SAND–94-1145C) **Development of a gas-generation model for the Waste Isolation Pilot Plant.** Brush, L.H. (Sandia National Labs., Albuquerque, NM (United States)); Storz, L.J.; Garner, J.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-931195–4: International symposium on scientific basis for nuclear waste management, Boston, MA (United States), 29 Nov - 3 dec 1993). Order Number DE94010756. Source: OSTI; NTIS; INIS; GPO Dep.

Design-basis transuranic (TRU) waste to be emplaced in the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico may generate significant quantities of gas, which may affect the performance of the WIPP with respect to regulations for radioactive and/or chemically hazardous waste constituents. We are developing a model to predict gas generation in WIPP disposal rooms during and after filling and sealing. Currently, the model includes: (1) oxic and anoxic corrosion of steels and other Fe-base alloys, including passivation and depassivation; (2) microbial degradation of cellulosics with O_2, NO_3^-, FeO(OH), SO_4^{2-}, or CO_2 as the

electron acceptor; (3) α radiolysis of brine; (4) consumption of CO_2 and, perhaps, H_2S by $Ca(OH)_2$ (in cementitious materials) and CaO (a potential backfill additive). The code simulates these processes and interactions among them by converting reactants (steels, cellulosics, etc.) to gases and other products at experimentally observed or estimated rates and plotting temporal reaction paths in three-dimensional phase diagrams for solids in the Fe-H_2O-CO_2-H_2-H_2S system.

20982 (SAND–94-1202C) **An overview of the mixed waste landfill integrated demonstration.** Williams, C.V.; Burford, T.D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404161–1: 4. annual waste-management education and research consortium technology development conference, Las Cruces, NM (United States), 10-15 Apr 1994). Order Number DE94012919. Source: OSTI; NTIS; INIS; GPO Dep.

Prior to May 1992, field demonstrations of characterization technologies were performed at an uncontaminated site near the Chemical Waste Landfill. In mid-1992 through summer 1993, both non-intrusive and intrusive characterization techniques were demonstrated at the Chemical Waste Landfill. Subsurface and dry barrier demonstrations were started in summer 1993 and will continue into 1995. Future plans include demonstrations of innovative drilling, characterization and long-term monitoring, and remediation techniques. Demonstrations were also scheduled in summer 1993 at the Kirtland Air Force HSWA site and will continue in 1994. The first phase of the Thermal Enhanced Vapor Extraction System (TEVES) project occurred in April 1992 when two holes were drilled and vapor extraction wells were installed at the Chemical Waste Landfill. Obtaining the engineering design and environmental permits necessary to implement this field demonstration will take until early 1994. Field demonstration of the vapor extraction system will occur in 1994.

20983 (SAND–94-1444C) **The use of supercritical carbon dioxide for contaminant removal from solid waste.** Adkins, C.L.J. (Sandia National Labs., Albuquerque, NM (United States)); Russick, E.M.; Smith, H.M.; Olson, R.B. Sandia National Labs., Albuquerque, NM (United States); Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000 ; AC04-76DP00613. (CONF-9406181–2: Joint Army, Navy, NASA, Air Force environmentally benign cleaning and degreasing technical workshop, Indian Head, MD (United States), 14-15 Jun 1994). Order Number DE94013342. Source: OSTI; NTIS; INIS; GPO Dep.

Supercritical carbon dioxide is being explored as a waste minimization technique for separating oils, greases and solvents from solid waste. The containments are dissolved into the supercritical fluid and precipitated out upon depressurization. The carbon dioxide solvent can then be recycled for continued use. Definitions of the temperature, pressure, flowrate and potential co-solvents are required to establish the optimum conditions for hazardous contaminant removal. Excellent extractive capability for common manufacturing oils, greases, and solvents has been observed in both supercritical and liquid carbon dioxide. Solubility measurements are being used to better understand the extraction process, and to determine if the minimum solubility required by federal regulations is met.

20984 (SR/H–668) **Savannah River Plant: Building 221-H, Process frame waste processing, bi-cylindrical Tank-AXC-25354-1/2: Project 981143.** Daking, D.E.; Sterrett, W.R. Hanford Works, Richland, WA (United States). 19 Dec 1961. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE94006178. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Reference tank is to be fabricated of Du Pont evaluated stainless steel SW820M Grade 820F, welded with Type 308ELC rod and fully X-rayed. A copy of the purchase order specifications stating full details is attached. The tank fabricator is Steel and Alloy Tank Co., Newark, New Jersey. The specifications cited require the tank fabricator to submit corrosion coupons per SW820M Section 7, which you will test in the manner outlined therein. This letter is to request special handling with respect to reports and records, plus an additional four day period on nitric acid tested material when test data indicate a trend towards intergranular attack.

20985 (SRT-ATS–940006) **Applied technology section: Monthly report, December 1993.** Buckner, M.R. Westinghouse Savannah River Co., Aiken, SC (United States). 28 Jan 1994. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012945. Source: OSTI; NTIS; GPO Dep.

This monthly report contains abstracts of the progress made in various projects from the applied technology section at the Savannah River Plant. Research areas include engineering modeling and simulation, applied physics, experimental thermal hydraulics, and packaging and transportation.

20986 (UCRL-ID–115768) **Study of cesium volatility from sodium carbonate based melts.** Ebbinghaus, B.B.; Krikorian, O.H.; Adamson, M.G.; Fleming, D.L. Lawrence Livermore National Lab., CA (United States). Dec 1993. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012588. Source: OSTI; NTIS; GPO Dep.

Purpose of this study was to obtain thermodynamic data on cesium volatility from sodium carbonate-based molten salts for application to the Rockwell-ETEC molten salt oxidation process. At 1073 to 1373 K, volatility tests were conducted on a horizontal and a vertical transpiration apparatus using a carrier gas composed of CO_2(g) and H_2O(g) which was passed over or bubbled through a sodium carbonate bath containing cesium carbonate and various additives. The major vapor species was identified to be CsOH(g) except when greater than 3% chloride is present in the melt, then the major vapor species is CsCl(g). The decrease in volatility of cesium as a function of cesium concentration in Cs_2CO_3_Na_2CO_3 mixtures follows Raoult's law very closely. Thus, this system exhibits close to ideal solution behavior. Addition of 22.5 wt % sodium sulfate decreases the cesium volatility by just under a factor of 2, and the addition of 10.0 wt % sodium chloride increases the cesium volatility about an order of magnitude. The addition of 2.0 wt % ash, molecular sieve, or silica show little or no effect. However, the data indicate that higher concentrations of ash will decrease the cesium volatility. For the addition of 22.5 wt % sodium sulfate the activity coefficient, $\gamma(Cs_2CO_3)^{\frac{1}{2}}$, is calculated to be 0.720 ± 0.068, and for the addition of 10.0 wt % sodium chloride, the activity coefficient, γ(CsCl), is calculated to be 8.118 ± 2.317. Assuming that Henry's law applies, these activity coefficients are used to extrapolate the effect on cesium retention in the molten salt oxidizer of sulfate and chloride at lower cesium concentrations.

20987 (UCRL-ID–116187-94-2) **Mixed waste management facility: Monthly report, February 1994.** Streit, R.D. Lawrence Livermore National Lab., CA (United States). Mar 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012445. Source: OSTI; NTIS; GPO Dep.

During February, significant progress was made toward the completion of the Conceptual Design (CD), particularly in developing a methodology and process for estimating CD costs and providing roll-up information in preparing the CD. As a result of this effort, a number of changes to the WBS were instituted to ensure that all key elements of the roll-up can be identified. Using the revised WBS, a bottom-up cost estimation for the CD was initiated, and an integrated schedule was developed. System Design Requirements and process flowsheets were frozen and placed under formal change control. An integrated project schedule was completed, including key project linkages between process engineering, permitting, B494 upgrade, and operations planning activities. Work also began to update the detailed PERT/critical-path schedule to reflect current CD plans. As a result of a number of DOE informal reviews during January and February, additional Project guidance was received for the preparation of several project documents and supporting information on the historical funding and manpower expenditures relative to identified milestones and markers. Documentation requested included the Technology Selection Plan for Primary Processes (Milestone 115-5) and reports and briefings addressing the implementation of Molten Salt oxidation (MSO). A

draft joint LLNL/ORNL Plan for the Demonstration and Deployment of the MSO Process was developed along with documentation for the resolution of MSO issues identified in the December 1993 MSO Technical Review.

20988 (UCRL-ID–116187-94-3) **Mixed Waste Management Facility monthly report, March 1994.** Streit, R.D. Lawrence Livermore National Lab., CA (United States). Apr 1994. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94013649. Source: OSTI; NTIS; GPO Dep.

In preparation for a validation of the FY96 budget submittal and overall project, DOE requested an early draft of the CD report by mid-April and a series of briefings late in April. The schedule for delivering the CD report was adjusted to meet these new requests. This is in addition to the Independent Cost Validation of the Conceptual Design that will be completed by DOE during May.

20989 (UCRL-JC–114118) **Modeling of UO_2 aqueous dissolution over a wide range of conditions.** Steward, S.A.; Weed, H.C. Lawrence Livermore National Lab., CA (United States). Nov 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-931108–102: Fall meeting of the Materials Research Society (MRS), Boston, MA (United States), 29 Nov - 3 dec 1993). Order Number DE94011615. Source: OSTI; NTIS; INIS; GPO Dep.

Previously it was not possible to predict reliably the rate at which spent fuel would react with groundwater because of conflicting data in the literature. The dissolution of the UO_2 spent fuel matrix is a necessary step for aqueous release of radioactive fission products. Statistical experimental design was used to plan a set of UO_2 dissolution experiments to examine systematically the effects of temperature (25–75C), dissolved oxygen (0.002–0.2 atm overpressure), pH (8–10) and carbonate ($2\text{-}200 \times 10^{-4}$ molar) concentrations on UO_2 dissolution. The average uranium dissolution rate was 4.3 mg/m_2/day. The regression fit of the data indicate an Arrhenius type activation energy of 8750 cal/mol and a half-power dependence on dissolved oxygen in the simulated groundwater.

20990 (UCRL-JC–114790) **Dispersivity in heterogeneous permeable media.** Chesnut, D.A. Lawrence Livermore National Lab., CA (United States). Jan 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940553–15: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94007870. Source: OSTI; NTIS; INIS; GPO Dep.

When one fluid displaces another through a one-dimensional porous medium, the composition changes from pure displacing fluid at the inlet to pure displaced fluid some distance downstream. The distance over which an arbitrary percentage of this change occurs is defined as the mixing zone length, which increases with increasing average distance traveled by the displacement front. For continuous injection, the mixing zone size can be determined from a breakthrough curve as the time required for the effluent displacing fluid concentration to change from, say, 10% to 90%. In classical dispersion theory, the mixing zone grows in proportion to the square root of the mean distance traveled, or, equivalently, to the square root of the mean breakthrough time. In a multi-dimensional heterogeneous medium, especially at field scales, the size of the mixing zone grows almost linearly with mean distance or travel time. If an observed breakthrough curve is forced to fit the, clinical theory, the resulting effective dispersivity, instead of being constant, also increases almost linearly with the spatial or temporal scale of the problem. This occurs because the heterogeneity in flow properties creates a corresponding velocity distribution along the different flow pathways from the inlet to the outlet of the system. Mixing occurs mostly at the outlet, or wherever the fluid is sampled, rather than within the medium. In this paper, we consider the effects. of this behavior on radionuclide or other contaminant migration.

20991 (UCRL-JC–116293) **An analysis of the Cured-in-Place Pipe (CIPP) subproject of the sanitary sewer rehabilitation project.** Morrow, W.; Siemiatkoski, S. Lawrence Livermore National Lab., CA (United States). 25 Jan 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940274–1: Pipe users group (PUG) annual seminar, Berkeley, CA (United States), 16 Feb 1994). Order Number DE94009915. Source: OSTI; NTIS; GPO Dep.

The comprehensive rehabilitation of the Lawrence Livermore National Laboratory Sanitary Sewer System centers around a Cured-in-Place Pipe project. Driven by regulatory requirements to eliminate the potential for exfiltration, a careful condition assessment of the existing infrastructure was conducted. Under programmatic constraints to maintain continuous operations, the INLINER USA cured-in-place pipe system was selected as the appropriate technology, and the project is currently under contract.

20992 (UCRL-JC–116315) **Identifying significant uncertainties in thermally dependent processes for repository performance analysis.** Gansemer, J.D.; Lamont, A. Lawrence Livermore National Lab., CA (United States). Jan 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940553–39: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94010061. Source: OSTI; NTIS; INIS; GPO Dep.

In order to study the performance of the potential Yucca Mountain Nuclear Waste Repository, scientific investigations are being conducted to reduce the uncertainty about process models and system parameters. This paper is intended to demonstrate a method for determining a strategy for the cost effective management of these investigations. It is not meant to be a complete study of all processes and interactions, but does outline a method which can be applied to more in-depth investigations.

20993 (UCRL-JC–117119) **Decision analysis of Hanford underground storage tank waste retrieval systems.** Merkhofer, M.W. (Applied Decision Analysis, Inc., Menlo Park, CA (United States)); Bitz, D.A.; Berry, D.L.; Jardine, L.J. Lawrence Livermore National Lab., CA (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ; AC04-94AL85000. (CONF-940553–61: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94012677. Source: OSTI; NTIS; INIS; GPO Dep.

A decision analysis approach has been proposed for planning the retrieval of hazardous, radioactive, and mixed wastes from underground storage tanks. This paper describes the proposed approach and illustrates its application to the single-shell storage tanks (SSTs) at Hanford, Washington.

20994 (USGS-OFR–93-269) **Characterizing fractured rock for fluid-flow, geomechanical, and paleostress modeling: Methods and preliminary results from Yucca Mountain, Nevada.** Barton, C.C.; Larsen, E.; Page, W.R.; Howard, T.M. Geological Survey, Denver, CO (United States). 1993. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI08-78ET44802. Order Number DE94013203. Source: OSTI; NTIS; INIS; GPO Dep.

Fractures have been characterized for fluid-flow, geomechanical, and paleostress modeling at three localities in the vicinity of drill hole USW G-4 at Yucca Mountain in southwestern Nevada. A method for fracture characterization is introduced that integrates mapping fracture-trace networks and quantifying eight fracture parameters: trace length, orientation, connectivity, aperture, roughness, shear offset, trace-length density, and mineralization. A complex network of fractures was exposed on three 214- to 260-m 2 pavements cleared of debris in the upper lithophysal unit of the Tiva Canyon Member of the Miocene Paint-brush Tuff. The pavements are two-dimensional sections through the three-dimensional network of strata-bound fractures. All fractures with trace lengths greater than 0.2 m were mapped and studied.

20995 (USGS-OFR–94-49) **The Sundance fault: A newly recognized shear zone at Yucca Mountain, Nevada.** Spengler, R.W. (Geological Survey, Denver, CO (United States)); Braun, C.A.; Martin, L.G.; Weisenberg, C.W. Geological Survey, Denver, CO (United States). 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI08-92NV10874. Order Number DE94009403. Source: OSTI; NTIS; INIS; GPO Dep.

Ongoing detailed mapping at a scale of 1:240 of structural features within the potential repository area indicates the presence of several previously unrecognized structural features. Minor north-trending west-side-down faults occur east and west of the Ghost Dance fault and suggest a total width of the Ghost Dance fault system of nearly 366 m (1200 ft). A zone of near-vertical N30° – 40°W – trending faults, at least 274 m (900 ft) wide, has been identified in the northern part of our study area and may traverse across the proposed repository area. On the basis of a preliminary analysis of available data, we propose to name this zone the "Sundance fault system" and the dominant structure, occurring near the middle of the zone, the "Sundance fault." Some field relations suggest left-stepping deflections of north-trending faults along a preexisting northwest-trending structural fabric. Other field observations suggest that the "Sundance fault system" offsets the Ghost Dance fault system in an apparent right lateral sense by at least 52 m (170 ft). Additional detailed field studies, however, are needed to better understand structural complexities at Yucca Mountain.

20996 (WHC-EP–0182-68) **Tank farm surveillance and waste status summary report for November 1993.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94010345. Source: OSTI; NTIS; GPO Dep.

This report is the official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. This report provides data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and supplemental information regarding tank surveillance anomalies and ongoing investigations. This report is intended to meet the requirement of US Department of Energy-Richland Operations Office Order 5820.2A, Chapter I. Section 3.e. (3) (DOE-RL, 1990, Radioactive Waste Management, US Department of Energy-Richland Operation Office, Richland, Washington) requiring the reporting of waste inventories and space utilization for Hanford Tank Farm Tanks.

20997 (WHC-EP–0474-11) **Quarterly report on ferrocyanide safety program for the period ending December 31, 1993.** Meacham, J.E.; Cash, R.J.; Dukelow, G.T. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94010341. Source: OSTI; NTIS; GPO Dep.

This is the eleventh quarterly report on the progress of activities addressing safety issues associated with Hanford Site high-level radioactive waste tanks that contain ferrocyanide compounds. In the presence of oxidizing materials, such as nitrates or nitrites, ferrocyanide can be made to explode in the laboratory by heating to high temperatures [above 285°C (545°F)]. In the mid 1950s, approximately 140 metric tons of ferrocyanide were added to waste now stored in underground high-level radioactive waste tanks. An implementation plan (Cash 1991) responding to the Defense Nuclear Facilities Safety Board Recommendation 90-7 (FR 1990) was issued in March 1991 describing the activities that were planned and underway to address each of the six parts of Recommendation 90-7. A revision to the original plan (Borsheim et al. 1992) was transmitted to the US Department of Energy by Westinghouse Hanford Company in December 1992, and subsequently to the Defense Nuclear Facilities Safety Board in 1993. The implementation plan was updated and revised this quarter and re-released as the ferrocyanide safety program plan (Borsheim et al, 1993a). The program plan still addresses the six parts of Recommendation 90-7; however, it also includes all work in the Ferrocyanide Safety Program. This quarterly report is reported against the new program plan.

20998 (WHC-EP–0579) **SY Tank Farm ventilation isolation option risk assessment report.** Powers, T.B.; Morales, S.D. Westinghouse Hanford Co., Richland, WA (United States). Mar 1994. 634p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94011452. Source: OSTI; NTIS; GPO Dep.

The safety of the 241-SY Tank Farm ventilation system has been under extensive scrutiny due to safety concerns associated with tank 101-SY. Hydrogen and other gases are generated and trapped in the waste below the liquid surface. Periodically, these gases are released into the dome space and vented through the exhaust system. This attention to the ventilation system has resulted in the development of several alternative ventilation system designs. The ventilation system provides the primary means of mitigation of accidents associated with flammable gases. This report provides an assessment of various alternatives ventilation system designs.

20999 (WHC-EP–0636) **Evaluation of existing Hanford buildings for the storage of solid wastes.** Carlson, M.C.; Hodgson, R.D.; Sabin, J.C. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94011450. Source: OSTI; NTIS; INIS; GPO Dep.

Existing storage space at the Hanford Site for solid low-level mixed waste (LLMW) will be filled up by 1997. Westinghouse Hanford Company (WHC) has initiated the project funding cycle for additional storage space to assure that new facilities are available when needed. In the course of considering the funding request, the US Department of Energy (DOE) has asked WHC to identify and review any existing Hanford Site facilities that could be modified and used as an alternative to constructing the proposed W-112 Project. This report documents the results of that review. In summary, no buildings exist at the Hanford Site that can be utilized for storage of solid LLMW on a cost-effective basis when compared to new construction. The nearest approach to an economically sensible conversion would involve upgrade of 100,000 ft^2 of space in the 2101-M Building in the 200 East Area. Here, modified storage space is estimated to cost about $106 per ft^2 while new construction will cost about $50 per ft^2. Construction costs for the waste storage portion of the W-112 Project are comparable with W-016 Project actual costs, with escalation considered. Details of the cost evaluation for this building and for other selected candidate facilities are presented in this report. All comparisons presented address the potential decontamination and decommissioning (D&D) cost avoidances realized by using existing facilities.

21000 (WHC-EP–0707) **216-U-10 Pond and 216-Z-19 Ditch characterization studies.** Last, G.V.; Duncan, D.W.; Graham, M.J.; Hall, M.D.; Hall, V.W.; Landeen, D.S.; Leitz, J.G.; Mitchell, R.M. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 463p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013007. Source: OSTI; NTIS; INIS; GPO Dep.

Includes maps.

The chemical, reprocessing of spent nuclear fuels at the US Department of Energy's Hanford Site has generated large volumes of radioactive liquid effluents. The majority of these effluents have been used strictly for cooling or other supportive functions and have been discharged to ditches and ponds. The 216-U-10 Pond and 216-Z-19 Ditch are two such disposal facilities. These facilities are components of an integrated system of ditches, ponds, and overflow facilities collectively referred to as the U-Pond disposal system. The U-Pond system has been used since 1943 and has received a large variety of radioisotopes from several sources. This study covered tho major aspects of the environment, including wind resuspension, biological uptake and transport, geologic distribution in surface and subsurface sediments, and ground-water impacts. The long-term use of U-Pond and the Z-19 Ditch has resulted in the localized accumulation of transuranic and fission product inventories as a result of sorption and filtration of particulates onto the uppermost sediments.

21001 (WHC-EP–0717) **Evaluation of 241 AN tank farm flammable gas behavior.** Reynolds, D.A. Westinghouse Hanford Co., Richland, WA (United States). Jan 1994. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012402. Source: OSTI; NTIS; GPO Dep.

The 241 AN Tank Farm tanks 241-AN-103, -104, and 105 are Flammable Gas Watch List tanks. Characteristics exhibited by these tanks (i.e., surface level drops, pressure increases, and

temperature profiles) are similar to those exhibited by tank 241-SY-101, which is also a Watch List tank. Although the characteristics exhibited by tank 241-SY-101 are also present in tanks 241-AN-103, -104, and 105, they are exhibited to a lesser degree in the AN Tank Farm tanks. The 241 AN Tank Farm tanks have only small surface level drops, and the pressure changes that occur are not sufficient to release an amount of gas that would cause the dome space to exceed the lower flammability limit (LFL) for hydrogen. Therefore, additional restrictions are probably unnecessary for working within the 241 AN Tank Farm, either within the dome space of the tanks or in the waste.

21002 (WHC-EP–0721) **Program plan for evaluation of the Ferrocyanide Waste Tank safety issue at the Hanford Site.** Borsheim, G.L.; Meacham, J.E.; Cash, R.J.; Dukelow, G.T. Westinghouse Hanford Co., Richland, WA (United States). Mar 1994. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94010340. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the background, priorities, strategy and logic, and task descriptions for the Ferrocyanide Waste Tank Safety Program. The Ferrocyanide Safety Program was established in 1990 to provide resolution of a major safety issue identified for 24 high-level radioactive waste tanks at the Hanford Site.

21003 (WHC-EP–0747) **Final report of the TWRS Plant Implementation Team to review potential reactive component in tank 241-T-111 and methane in tank 241-SY-101 gas release event.** Engelman, D.B. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012400. Source: OSTI; NTIS; INIS; GPO Dep.

This is the final report of the results of a Tank Waste Remediation Systems Plant Implementation Team chartered by TWRS Operations, in response to a potential Unreviewed Safety Question (USQ) due to the discovery of a reactive component in waste tank 241-T-111 (T-111). Tank T-111, a non-Watch List single-shell tank, has no historical evidence of any potential safety problems. Core samples from tank T-111 were taken in 1991 and analyzed in 1992. The presence of uncharacterized exotherms was identified in the first three segments of two cores and reported to tank farm management in November 1993.

21004 (WHC-EP–0750-Vol.1) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 1.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 212p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012249. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this Requirements Identification Document (RID) section is to identify, in one location, all of the facility specific requirements and good industry practices which are necessary or important to establish an effective Issues Management Program for the Tank Farm Facility. The Management Systems Functional Area includes the site management commitment to environmental safety and health (ES&H) policies and controls, to compliance management, to development and management of policy and procedures, to occurrence reporting and corrective actions, resource and issue management, and to the self-assessment process.

21005 (WHC-EP–0750-Vol.2) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 2.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 270p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012250. Source: OSTI; NTIS; INIS; GPO Dep.

The Quality Assurance Functional Area Requirements Identification Document (RID), addresses the programmatic requirements that ensure risks and environmental impacts are minimized, ensure safety, reliability, and performance are maximized through the application of effective management systems commensurate with the risks posed by the Tank Farm Facility and its operation. This RID incorporates guidance intended to provide Tank Farms management with the necessary requirements information to develop, upgrade, or assess the effectiveness of a Quality Assurance Program in the performance of organizational and functional activities. Quality Assurance is defined as all those planned and systematic actions necessary to provide adequate confidence that a facility, structure, system, or component will perform satisfactorily and safely in service. This document will provide the specific requirements to meet DNFSB recommendations and the guidance provided in DOE Order 5700.6C, utilizing industry codes, standards, regulatory guidelines, and industry good practices that have proven to be essential elements for an effective and efficient Quality Assurance Program as the nuclear industry has matured over the last thirty years.

21006 (WHC-EP–0750-Vol.3) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 3.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 221p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012301. Source: OSTI; NTIS; INIS; GPO Dep.

The Safeguards and Security (S&S) Functional Area address the programmatic and technical requirements, controls, and standards which assure compliance with applicable S&S laws and regulations. Numerous S&S responsibilities are performed on behalf of the Tank Farm Facility by site level organizations. Certain other responsibilities are shared, and the remainder are the sole responsibility of the Tank Farm Facility. This Requirements Identification Document describes a complete functional Safeguards and Security Program that is presumed to be the responsibility of the Tank Farm Facility. The following list identifies the programmatic elements in the S&S Functional Area: Program Management, Protection Program Scope and Evaluation, Personnel Security, Physical Security Systems, Protection Program Operations, Material Control and Accountability, Information Security, and Key Program Interfaces.

21007 (WHC-EP–0750-Vol.5) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 5.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012303. Source: OSTI; NTIS; INIS; GPO Dep.

The Fire Protection functional area for the Hanford Site Tank Farm facilities and support structures is based on the application of relevant DOE orders, regulations, and industry codes and standards. The fire protection program defined in this document may be divided into three areas: (1) organizational, (2) administrative programmatic features, and (3) technical features. The information presented in each section is in the form of program elements and orders, regulations, industry codes, and standards that serve as the attributes of a fire protection program for the Tank Farm facilities. Upon completion this document will be utilized as the basis to evaluate compliance of the fire protection program being implemented for the Tank Farm facilities with the requirements of DOE orders and industry codes and standards.

21008 (WHC-EP–0750-Vol.6) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 6.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 203p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012304. Source: OSTI; NTIS; INIS; GPO Dep.

The scope of the Environmental Restoration and Waste Management (EM) Functional Area includes the programmatic controls associated with the management and operation of the Hanford Tank Farm Facility. The driving management organization implementing the programmatic controls is the Tank Farms Waste Management (WM)organization whose responsibilities are to ensure that performance objectives are established; and that measurable criteria for attaining objectives are defined and reflected in programs, policies and procedures. Objectives for the WM Program include waste minimization, establishment of effective waste segregation methods, waste treatment technology development, radioactive (low-level, high-level) hazardous and mixed waste transfer, treatment, and storage, applicability of a corrective action program, and management and applicability of a decontamination and decommissioning (D&D) program in future years.

21009 (WHC-MR–0438) **Type B Investigation Report for 241-SY-101 Pump Start and 241-C-106 Pit Cleanout.** Ewalt, J.R.

Westinghouse Hanford Co., Richland, WA (United States). Sep 1993. 232p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94009438. Source: OSTI; NTIS; GPO Dep.

In accordance with the direction of the Department of Energy (DOE) Manager, Richland Operations Office, a Type "B" investigation in accordance with the DOE Order 5484.1, Environmental Protection, Safety and Health Protection Information Reporting Requirements, has been conducted. The scope of the investigation included two events: The "Inadvertent Mixer Pump Operation at 241-SY-101" (RL-WHC-TANK FARM-1993-069); "Inadequate Work Control Results in Personnel Skin Contamination at 241-C-106, Pit B" (RL-WHC-TANK FARM-1993-071) events. Additionally, at the request of the President of the WHC, a broader investigation into Waste Tank Farm "safety practices" and "Conduct of Operations" was also conducted. The review was focused on (1) WHC organizations performing operations, maintenance, and radiological safety tasks; and (2) KEH organizations performing major maintenance tasks.

21010 (WHC-SA–2077) **308 Building Zone I stabilization and confinement.** Metcalf, I.L.; Schwartz, K.E.; Rich, J.W.; Benecke, M.W.; Rasmussen, D.E. Westinghouse Hanford Co., Richland, WA (United States). Oct 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9310264–4: 1993 plutonium/uranium recovery operations conference, Augusta, GA (United States), 18-21 Oct 1993). Order Number DE94013573. Source: OSTI; NTIS; INIS; GPO Dep.

The 308 Building (Fast Flux Test Facility [FFTF] fuel supply) at the Hanford Site, located in Richland, Washington, is currently in transition to shutdown status. After shutdown, the facility will be maintained/surveilled and turned over to the U.S. Department of Energy (DOE) Office of Facility Transition and Management (EM-60) for utilization, remedial action, or decontamination and decommissioning (D&D). This may require that the facility be maintained in the shutdown mode for up to 30 years. To date, all of the special nuclear material (SNM) has been removed from the facility, potential fuel supply equipment has been preserved, surplus materials and equipment have been excessed, and enclosure cleanup and stabilization has begun. Shutdown planning has been completed, which outlines the major tasks, scope, methodology, and timing for the shutdown activities. A major activity in support of the 308 Building shutdown is the cleanup and stabilization of the enclosures and surface contamination areas. This document identifies the specific designs, processes, and methods to stabilize and confine the radiological material within the enclosures and exhaust ducts to allow shutdown of the active support systems. The designs and steps planned will be effective, are simple, and make maximum use of current technologies and commercial items.

21011 (WHC-SA–2113) **Minimization of effluent discharge to the Soil Column.** Dronen, V.R.; Hydzik, K.M. Westinghouse Hanford Co., Richland, WA (United States). Jan 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940225–85: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94009436. Source: OSTI; NTIS; GPO Dep.

In 1987, the US Congress mandated that the US Department of Energy (DOE), cease discharge of contaminated effluents to the soil column at the Hanford Site by calendar year 1995. The plan and schedule for this activity can be found in The Plan and Schedule to Discontinue Disposal of Contaminated Liquid into the Soil Column at the Hanford Site, (WHC 1987). Coupled with this mandate and DOE's intent to cleanup Hanford (remediate and restore to the extent practicable), DOE entered into an agreement with the US Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology). The agreement is called the "Hanford Federal Facility Agreement and Consent Order" (Ecology et al. 1992) otherwise known as the Tri-Party Agreement. The Tri-Party Agreement established schedules and legally enforceable milestones for the Hanford cleanup mission. One such milestone was to cease discharge of effluent to Hanford's 300 Area process trenches located approximately 100 m from the Columbia River, north of Richland, Washington.

21012 (WHC-SA–2167) **A NEPA compliance strategy plan for providing programmatic coverage to agency problems.** Eccleston, C.H. Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940650–5: Annual conference and exposition of the National Association of Environmental Professionals: global strategies for environmental issues, New Orleans, LA (United States), 12-15 Jun 1994). Order Number DE94013009. Source: OSTI; NTIS; INIS; GPO Dep.

The National Environmental Policy Act (NEPA) of 1969, requires that all federal actions be reviewed before making a final decision to pursue a proposed action or one of its reasonable alternatives. The NEPA process is expected to begin early in the planning process. This paper discusses an approach for providing efficient and comprehensive NEPA coverage to large-scale programs. Particular emphasis has been given to determining bottlenecks and developing workarounds to such problems. Specifically, the strategy is designed to meet four specific goals: (1) provide comprehensive coverage, (2) reduce compliance cost/time, (3) prevent project delays, and (4) reduce document obsolescence.

21013 (WHC-SA–2217) **Laboratory information management system at the Hanford Site.** Leggett, W.; Barth, D.; Ibsen, T.; Newman, B. Westinghouse Hanford Co., Richland, WA (United States). Mar 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940301–28: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994). Order Number DE94011335. Source: OSTI; NTIS; INIS; GPO Dep.

In January of 1994 an important new technology was brought on line to help in the monumental waste management and environmental restoration work at the Hanford Site. Cleanup at the Hanford Site depends on analytical chemistry information to identify contaminates, design and monitor cleanup processes, assure worker safety, evaluate progress, and prove completion. The new technology, a laboratory information management system (LIMS) called "LABCORE," provides the latest systems to organize and communicate the analytical tasks: track work and samples; collect and process data, prepare reports, and store data in readily accessible electronic form.

21014 (WHC-SA–2347) **Integral TRU measurements in Hanford waste tanks using gas analysis.** Wittekind, W.D. (Westinghouse Hanford Co., Richland, WA (United States)); Toffer, H.; Koglin, J.E. Westinghouse Hanford Co., Richland, WA (United States). May 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940815–9: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013008. Source: OSTI; NTIS; INIS; GPO Dep.

It is possible to assess the TRU content of a Hanford waste tank using an integral gas measurement in the tank head space. An integral transuranic (TRU) measurement is an assessment of the entire system such as a tank for TRU content. Waste tanks up to 75 feet diameter and 1,000,000 gallon capacity can be measured, however a number of specific challenges need to be overcome. Integral TRU measurements involve gas analysis for noble gases. Helium (decay product), krypton and xenon (fission products) and radon (daughter product) are noble gases. Noble gases would be expected to diffuse through most waste forms and, after achieving saturation, diffuse out of the waste form. Noble gases would, depending on air exchange rates, achieve equilibrium in the air space above the waste form. Helium measurements were performed on air from the head space in two Hanford waste tanks. Analytical results from one tank showed a statistically significant elevation above natural background helium implying source TRU presence.

21015 (WHC-SA–2439) **Pollution prevention opportunity assessment benchmarking: Recommendations for Hanford.** Engel, J.A. Isuzu Motors Ltd., Southfield, MI (United States). May 1994. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013083. Source: OSTI; NTIS; INIS; GPO Dep.

Pollution Prevention Opportunity Assessments (P2OAs) are an important first step in any pollution prevention program. While P2OAs have been and are being conducted at Hanford, there

exists no standard guidance, training, tracking, or systematic approach to identifying and addressing the most important waste streams. The purpose of this paper then is to serve as a guide to the Pollution Prevention group at Westinghouse Hanford in developing and implementing P2OAs at Hanford. By searching the literature and benchmarks other sites and agencies, the best elements from those programs can be incorporated and pitfalls more easily avoided. This search began with the 1988 document that introduces P2OAs (then called Process Waste Assessments, PWAS) by the Environmental Protection Agency. This important document presented the basic framework of P20A features which appeared in almost all later programs. Major Department of Energy programs were also examined, with particular attention to the Defense Programs P20A method of a graded approach, as presented at the Kansas City Plant. The graded approach is a system of conducting P2OAs of varying levels of detail depending on the size and importance of the waste stream. Finally, private industry programs were examined briefly. While all the benchmarked programs had excellent features, it was determined that the size and mission of Hanford precluded lifting any one program for use. Thus, a series of recommendations were made, based on the literature review, in order to begin an extensive program of P2OAs at Hanford. These recommendations are in the areas of: facility Pollution Prevention teams, P20A scope and methodology, guidance documents, training for facilities (and management), technical and informational support, tracking and measuring success, and incentives.

21016 (WHC-SA–2460) **Creating a proper safety culture at the Hanford Site low- and high-level waste vitrification plant projects.** Baide, D.G.; Herborn, D.I. Westinghouse Hanford Co., Richland, WA (United States). May 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940815–26: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013585. Source: OSTI; NTIS; INIS; GPO Dep.

The United States has been engaged in defense nuclear activities at the Hanford Site for the past 50 years. To date, no high-level waste and only 3,800 m^3 of low-level waste have been processed for final disposal. By the anticipated start of low-level waste processing operations in the year 2005, approximately 215,000 m^3 of low-level waste will be in underground storage tanks (90% of the total tank waste in storage). Similarly, approximately 25,000 m^3 of high-level waste will be in underground storage by the anticipated start of high-level waste processing operations in the year 2009 (10% of the total tank waste in storage).

21017 (WHC-SD-EN-TP–036) **Soil washing physical separations test procedure - 300-FF-1 operable unit.** Belden, R.D. Westinghouse Hanford Co., Richland, WA (United States). 8 Oct 1993. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013012. Source: OSTI; NTIS; INIS; GPO Dep.

This procedure provides the operations approach, a field sampling plan, and laboratory procedures for a soil washing test to be conducted by Alternative Remedial Technologies, Inc. (ART) in the 300-FF-1 area at the Hanford site. The "Quality Assurance Project Plan for the Soil Washing Physical Separations Test, 300-FF-1 Operable Unit," Hanford, Washington, Alternative Remedial Technologies, Inc., February 1994 (QAPP) is provided in a separate document that presents the procedural and organizational guidelines for this test. This document describes specifications, responsibilities, and general procedures to be followed to conduct physical separation soil treatability tests in the North Process Pond of the 300-FF-1 Operable Unit (OU) at the Hanford Site. These procedures are based on the "300-FF-1 Physical Separations CERCLA Treatability Test Plan, DOE/RL 92-2l," (DOE-RL 1993).

21018 (WHC-SD-W026-PMP–002) **Project management plan, Waste Receiving and Processing Facility, Module 1, Project W-026.** Starkey, J.G. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94011593. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Waste Receiving and Processing Facility Module 1 Project (WRAP 1) has been established to support the retrieval and final disposal of approximately 400K grams of plutonium and quantities of hazardous components currently stored in drums at the Hanford Site.

21019 (WHC-SD-WM-RD–044) **Evaluation of melter system technologies for vitrification of high-sodium content low-level radioactive liquid wastes.** Wilson, C.N. Westinghouse Hanford Co., Richland, WA (United States). 21 Mar 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94011330. Source: OSTI; NTIS; INIS; GPO Dep.

Westinghouse Hanford Company (WHC) is conducting a two-phased demonstration testing and evaluation of candidate melter system technologies for vitrification of Hanford Site low-level tank wastes. The testing is to be performed by melter equipment and vitrification technology commercial suppliers. This Statement of Work is for Phases 1 and 2 of the demonstration testing program. The primary objective of the demonstration testing is to identify the best available melter system technology for the Hanford Site LLW vitrification facility. Data obtained also will support various WHC engineering studies and conceptual design of the LLW vitrification facility. Multiple technologies will be selected for demonstration and evaluation. Testing will be conducted using non-radioactive LLW simulants in Seller-specified pilot/testing facilities.

21020 (WHC-SD-WM-TI–540) **Analysis report for 241-BY-104 auger samples.** Beck, M.A.; Bechtold, D.B.; Hey, B.E. Westinghouse Hanford Co., Richland, WA (United States). 26 Oct 1992. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013578. Source: OSTI; NTIS; INIS; GPO Dep.

This document details the analytical sample results for two auger samples of the tip 15 cm (6 in.) of tank 241-BY-104 salt cake. The thermal response of tank 241-BY-104 auger samples is generally mild. The level of cyanide and iron, and therefore of ferrocyanide is very low. Evidence of inhomogeneity is present for tank 241-By-104 salt cake. Mass and charge balances were less than ideal. The concentrations found for the major constituents, except chromium, are in line with the expectations.

21021 (WHC-SP–1072) **Disposition of PUREX facility tanks D5 and E6 uranium and plutonium solutions: Final report.** Harty, D.P. Westinghouse Hanford Co., Richland, WA (United States). Dec 1993. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94011414. Source: OSTI; NTIS; INIS; GPO Dep.

Approximately 9 kilograms of plutonium and 5 metric tons of uranium in a 1 molar nitric acid solution are being stored in two PUREX facility vessels, tanks D5 and E6. The plutonium was accumulated during cleanup activities of the plutonium product area of the PUREX facility. Personnel at PUREX recently completed a formal presentation to the Surplus Materials Peer Panel (SMPP) regarding disposition of the material currently in these tanks. The peer panel is a group of complex-wide experts who have been chartered by EM-64 (Office of Site and Facility Transfer) to provide a third party independent review of disposition decisions. The information presented to the peer panel is provided in the first section of this report. The panel was generally receptive to the information provided at that time and the recommendations which were identified.

21022 (WINCO–1205) **Spent Fuel and Waste Management Technology Development Program: Annual progress report.** Bryant, J.W. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Jan 1994. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE94012591. Source: OSTI; NTIS; INIS; GPO Dep.

This report provides information on the progress of activities during fiscal year 1993 in the Spent Fuel and Waste Management Technology Development Program (SF&WMTDP) at the Idaho Chemical Processing Plant (ICPP). As a new program, efforts are just getting underway toward addressing major issues related to the fuel and waste stored at the ICPP. The SF&WMTDP has the following principal objectives: Investigate direct dispositioning of spent fuel, striving for one acceptable waste form; determine the

best treatment process(es) for liquid and calcine wastes to minimize the volume of high level radioactive waste (HLW) and low level waste (LLW); demonstrate the integrated operability and maintainability of selected treatment and immobilization processes; and assure that implementation of the selected waste treatment process is environmentally acceptable, ensures public and worker safety, and is economically feasible.

21023 (WINCO–1209) **Graphite fuels combustion off-gas treatment options.** Kirkham, R.J.; Lords, R.E. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Mar 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. (WIN–306-Rev.1). Order Number DE94013672. Source: OSTI; NTIS; INIS; GPO Dep.

Scenarios for burning bulk graphite and for burning crushed fuel particles from graphite spent nuclear fuels have been considered. Particulates can be removed with sintered metal filters. Subsequent cooling would then condense semi-volatile fission products into or onto a particulate. These particulates would be trapped by a second sintered metal filter or downstream packed bed. A packed bed scrub column can be used to eliminate most of the iodine-129 and tritium. A molecular sieve bed is proposed to collect the residual ^{129}I and other tramp radionuclides downstream (Ruthenium, etc.). Krypton-85 can be recovered, if need be, either by cryogenics or by the KALC process (Krypton Adsorption in Liquid Carbon dioxide). Likewise carbon-14 in the form of carbon dioxide could be collected with a caustic or lime scrub solution and incorporated into a grout. Sulfur dioxide present will be well below regulatory concern level of 4.0 tons per year and most of it would be removed by the scrubber. Carbon monoxide emissions will depend on the choice of burner and start-up conditions. Should the system exceed the regulatory concern level, a catalytic converter in the final packed bed will be provided. Radon and its daughters have sufficiently short half-lives (less than two minutes). If necessary, an additional holdup bed can be added before the final HEPA filters or additional volume can be added to the molecular sieve bed to limit radon emissions. The calculated total effective dose equivalent at the Idaho National Engineering Laboratory boundary from a single release of all the ^{3}, ^{14}C, ^{85}Kr, and ^{129}I in the total fuel mass if 0.43 mrem/year.

21024 (WINCO–1210) **High-level waste issues and resolutions document.** Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). May 1994. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE94013673. Source: OSTI; NTIS; INIS; GPO Dep.

The High-Level Waste (HLW) Issues and Resolutions Document recognizes US Department of Energy (DOE) complex-wide HLW issues and offers potential corrective actions for resolving these issues. Westinghouse Management and Operations (M&O) Contractors are effectively managing HLW for the Department of Energy at four sites: Idaho National Engineering Laboratory (INEL), Savannah River Site (SRS), West Valley Demonstration Project (WVDP), and Hanford Reservation. Each site is at varying stages of processing HLW into a more manageable form. This HLW !ssues and Resolutions Document identifies five primary issues that must be resolved in order to reach the long-term objective of HLW repository disposal. As the current M&O contractor at DOE's most difficult waste problem sites, Westinghouse recognizes that they have the responsibility to help solve some of the complexes' HLW problems in a cost effective manner by encouraging the M&Os to work together by sharing expertise, eliminating duplicate efforts, and sharing best practices. Pending an action plan, Westinghouse M&Os will take the initiative on those corrective actions identified as the responsibility of an M&O. This document captures issues important to the management of HLW. The proposed resolutions contained within this document set the framework for the M&Os and DOE work cooperatively to develop an action plan to solve some of the major complex-wide problems. Dialogue will continue between the M&Os, DOE, and other regulatory agencies to work jointly toward the goal of storing, treating, and immobilizing HLW for disposal in an environmentally sound, safe, and cost effective manner.

21025 (WSRC-MS–93-535) **Radiolytic bubble formation and level changes in simulated high-level waste salts and sludges – application to Savannah River Site and Hanford Storage tanks.** Walker, D.D.; Crawford, C.L.; Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940225–63: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94007970. Source: OSTI; NTIS; INIS; GPO Dep.

Radiolytically-produced bubbles of trapped gas are observed in simulated high-level waste (HLW) damp salt cake exposed to Co-60 gamma radiation. As the damp salt cake is irradiated, its volume increases due to the formation of trapped gas bubbles. Based on the increase in volume, the rate of trapped gas generation varies between 0.04 and 0.2 molecules/100 eV of energy deposited in the damp salt cake. The maximum volume of trapped gas observed in experiments is in the range 21–26 vol %. After reaching these volumes, the gas bubbles begin to escape. The generated gas includes hydrogen, oxygen, and nitrous oxide. The ratio in which these components are produced depends on the composition of the waste. Nitrous oxide production increases with the amount of sodium nitrite. Gases trapped by this mechanism may account for some of the observed level changes in Savannah River Site and Hanford waste tanks.

21026 (WSRC-MS–93-557) **Implementation of abnormal operation scenarios into the DWPF process plant simulator.** Ozkardesh, K. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940456–18: 1994 Society for Computer Simulation multiconference, San Diego, CA (United States), 11-15 Apr 1994). Order Number DE94010150. Source: OSTI; NTIS; GPO Dep.

The Defense Waste Processing Facility (DWPF) will be used by the Department of Energy to process high level liquid radioactive waste into a stable and manageable solid form. The facility requires a performance-based operator training program to satisfy DOE orders and guidelines. The control room operator training portion of this program is conducted on the DWPF Process Plant Simulator and is divided into normal and abnormal operations training. Normal operations training reflects the normal manual and automatic operations of the process. Abnormal operations training initiates equipment failures and process upsets in order to train the operators on transient operation and safe shutdown of a specific DWPF process. Abnormal operations g requires the capability of the DWPF Process Plant Simulator to initiate and manage predefined malfunction scenarios as needed by the training instructors. This paper will discuss the implementation of abnormal operation scenarios capability into the DWPF Process Plant Simulator.

21027 (WSRC-MS–93-581-Rev.1) **Accident simulation in a chemical process facility at the Savannah River Site: Revision 1.** Hope, E.P. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940456–7-Rev.1: 1994 Society for Computer Simulation multiconference, San Diego, CA (United States), 11-15 Apr 1994). Order Number DE94006377. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy requires Westinghouse Savannah River Company to safely operate the chemical separations facilities at the Savannah River Site (SRS). As part of the safety analysis program, simulation of a proposed frame waste recovery (FWR) system is needed to determine the possible accident consequences that may affect public safety. This paper details the simulation process for the proposed frame waste recovery process and describes the analytical tools used in order to make estimates of accident consequences. Since the process in question has been operated, historical data and statistics about its operation are available. Software tools have been developed to allow analysis of the frame waste recovery system, including the generation of system specific dose conversion factors for a number of unique situations. Accident scenarios involving spilled liquid material are analyzed and account for the specific floor geometry of the facility. Confinement and filtration systems are considered. Analysis of source terms is a limiting factor which affects the entire evaluation process. In the past, facility source terms were generally constant with occasional variations from established patterns. As new site missions unfold, significant

variations in source terms can be expected. The impact of these variations on the safety analysis is discussed.

21028 (WSRC-MS–94-061) **Recent results on the solubility of uranium and plutonium in Savannah River Site waste supernate.** Karraker, D.G.; Hobbs, D.T. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940225–71: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94007972. Source: OSTI; NTIS; INIS; GPO Dep.

High-level waste (HLW) is stored at the Savannah River Site (SRS) in a highly alkaline condition to prevent corrosion of the carbon steel storage tanks. Major components in the liquid phase include nitrate, hydroxide, nitrite, aluminate, carbonate and sulfate. Minor components include chloride, fluoride, oxalate and phosphate. The low solubility of uranium and plutonium in the HLW becomes significant to nuclear safety analyses when the supernate is evaporated to solids to conserve waste storage space and then redissolved to process for permanent disposal. The study of uranium and plutonium solubility in synthetic waste tank solutions was initiated to define actinide behavior during waste removal operations.

21029 (WSRC-MS–94-067) **Conducting operations at the Solid Waste Management Department at WRSC.** Bloedau, R.K.; Scogin, J.T. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940225–31: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94007187. Source: OSTI; NTIS; INIS; GPO Dep.

Conduct of Operations, which is one of the entities within the Westinghouse Savannah River Company's Performance Improvement Plan, is based on commercial nuclear power industry standards that were developed to improve operations in that industry. Implementation and compliance to the Conduct of Operations requirements are enhancing the Site's Mission: To serve the national interest of the United States by safely producing nuclear materials while protecting the employee and public health, as well as the environment. It also contributes to our Site's Vision: To be the recognized model of excellence for the United States Department of Energy Nuclear Weapons Complex, valuing and involving the individual to continually improve operations, safety, health environmental protection, quality, and customer satisfaction.

21030 (WSRC-MS–94-0188) **Physical sampling for site and waste characterization.** Bonnough, T.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–7: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94012447. Source: OSTI; NTIS; INIS; GPO Dep.

Physical sampling plays a basic role in site and waste characterization program effort. The term "physical sampling" used here means collecting tangible, physical samples of soil, water, air, waste streams, or other materials. The industry defines the term "physical sampling" broadly to include measurements of physical conditions such as temperature, wind conditions, and pH which are also often taken in a sample collection effort. Most environmental compliance actions are supported by the results of taking, recording, and analyzing physical samples and the measuring of physical conditions taken in association with sample collecting.

21031 (WSRC-MS–94-0208) **Process waste assessment for solid low-level radioactive waste and solid TRU waste.** Haney, L. (Westinghouse Savannah River Co., Aiken, SC (United States)); Gamble, G.S. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–3: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94010149. Source: OSTI; NTIS; GPO Dep.

Process Waste Assessments (PWAs) are a necessary and important part of a comprehensive waste management plan. PWAs are required by Federal RCRA regulations, certain state regulations and Department of Energy Orders. This paper describes the assessment process and provides examples used by Law Environmental, Inc., in performing numerous PWAs at the Savannah River Site in Aiken, SC.

21032 (WSRC-MS–94-0308) **Comparison of TCLP and long-term PCT performance on low-level mixed waste glasses.** Cicero, C.A.; Andrews, M.K.; Bickford, D.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–19: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013290. Source: OSTI; NTIS; INIS; GPO Dep.

The Mixed Waste Integrated Program (MWIP) of the US Department of Energy (DOE) is currently investigating technologies for conversion of low-level mixed waste (LLMW) into a form suitable for permanent disposal. Vitrification is one of the preferred technologies since it is capable of consistently producing a durable, leach resistant wasteform, while simultaneously minimizing disposal volumes. Since vitrification of LLMW is a relatively new concept, final wasteform specifications have not been developed. The Savannah River Technology Center (SRTC) of the Westinghouse Savannah River Company (WSRC) has developed the Product Consistency Test (PCI), which is a 7-day leaching procedure for glass. Comparison indicates that both tests have merit where LLMW glasses are concerned. The TCLP is an important test for determining the release of metals and for allowing the wasteform to be delisted while the PCT is more useful for determining consistent production of durable glass. It is a better indicator of the behavior of glass in disposal site conditions. Most aggressive leaching of common oxide glasses occurs under caustic rather than acidic conditions, therefore it is necessary to perform both tests. Further tests will be conducted using additional glass compositions and variations in the TCLP and the PCT.

21033 (WSRC-MS–94-0312) **Development of a thermal transient calculational tool for High Level Waste tanks.** Kielpinski, A.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–35: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013658. Source: OSTI; NTIS; INIS; GPO Dep.

Thermal design constraints exist on the processing operations in the High Level Waste (HLW) tanks of the Savannah River Site (SRS). A FORTRAN computer code was developed to provide a simple, fast, and reasonably accurate analysis tool for plant operation design. The code computes a lumped transient temperature for the liquid contents of a waste tank by modeling the liquid (slurry), the vapor space above it, the tank wall, and the cooling air outside of the tank. Results for a typical processing cycle of several months' duration can be obtained in 2-4 minutes CPU time on a VAX computer. This paper discusses the code's mathematical models, presents model results for a typical HLW process schedule, and compares the code predictions with operations data.

21034 (WSRC-MS–94-0326) **DWPF welder parametric study.** Eberhard, B.J.; Harbour, J.R.; Plodinec, M.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–33: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013663. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the DWPF Startup Test Program, a parametric study has been performed to determine a range of welder operating parameters which will produce acceptable final welds for canistered waste forms. The parametric window of acceptable welds defined by this study is 90,000 ± 15,000 lb of force, 248,000 ± 22,000 amps of current, and 95 ± 15 cycles (@ 60 cops) for the time of application of the current.

21035 (WSRC-RP–92-1360) **Radiological performance assessment for the Z-Area Saltstone Disposal Facility.** Cook, J.R.

(Westinghouse Savannah River Co., Aiken, SC (United States)); Fowler, J.R. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States); EG and G Idaho, Inc., Idaho Falls, ID (United States); Westinghouse Hanford Co., Richland, WA (United States); Westinghouse Savannah River Co., Aiken, SC (United States). 18 Dec 1992. 576p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94009115. Source: OSTI; NTIS; INIS; GPO Dep.

This radiological performance assessment (RPA) for the Savannah River Site (SRS) Saltstone Disposal Facility (SDF) was prepared in accordance with the requirements of Chapter III of the US Department of Energy Order 5820.2A. The Order specifies that an RPA should provide reasonable assurance that a low-level waste (LLW) disposal facility will comply with the performance objectives of the Order. The performance objectives require that: (1) exposures of the general public to radioactivity in the waste or released from the waste will not result in an effective dose equivalent of 25 mrem per year; (2) releases to the atmosphere will meet the requirements of 40 CFR 61; (3) inadvertent intruders will not be committed to an excess of an effective dose equivalent of 100 mrem per year from chronic exposure, or 500 mrem from a single acute exposure; and (4) groundwater resources will be protected in accordance with Federal, State and local requirements.

21036 (WSRC-RP–93-1227) **DWPT Program Plan: Evaluation of alternative Hanford Waste Vitrification Plant flowsheets in the Integrated DWPF Melter System.** Huston, N.D. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94005522. Source: OSTI; NTIS; INIS; GPO Dep.

This Program Plan outlines the activities to be conducted in the WSRC Integrated DWPF Melter System (IDMS) in continued support of the design, construction, and operation of the Hanford Waste Vitrification Plant (HWVP). In FY 1994, SRTC will conduct two runs in the IDMS facility in order to evaluate two alternative NCAW (Neutralized Current Acid Waste) melter feed preparation flowsheets. These alternative flowsheets have been developed by Battelle Pacific Northwest Laboratory (PNL) and Westinghouse Hanford Company (WHC) in an effort to minimize the amounts of hydrogen and ammonia produced in the melter feed preparation process.

21037 (WSRC-RP–93-1381) **Additional evaluation of "LDS Moldable" for melter construction.** Yau, W.W.F. Westinghouse Savannah River Co., Aiken, SC (United States). 8 Oct 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94005523. Source: OSTI; NTIS; INIS; GPO Dep.

Use of "LDS Moldable" as a cushion material for future DWPF melters is deemed feasible, because it serves the purpose of reducing the stress in the steel shell to acceptable levels. The assessment is based on the design geometry of the DWPF melter currently undergoing testing.

21038 (WSRC-RP–94-148) **An investigation of the radiolytic stability of a resorcinol-formaldehyde ion exchange resin.** Crawford, C.L.; Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Jan 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94009113. Source: OSTI; NTIS; GPO Dep.

Developing and demonstrating waste separations technologies are the principal objectives of the Underground Storage Tank - Integrated Demonstration (UST-ID) Program carried out by Pacific Northwest Laboratories (PNL) at the DOE Hanford site. One planned separation technique utilizes ion exchange for removal of cesium and strontium from high-level liquid supernates. A resorcinol-formaldehyde resin, which is a polycondensation-type cation exchange resin for cesium removal, has been developed at the Savannah River Technology Center (SRTC) and has demonstrated superlative performance in testing at SRS, Oak Ridge and PNL. Advantages of this resin relative to other media for cesium removal are its high capacity for cesium and its compatibility with the high pH and aluminum and sodium concentrations of both Hanford and SRS high-level liquid wastes.

21039 (WSRC-TR–93-100-9) **Savannah River Technology Center monthly report.** Ferrell, J.M. Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011165. Source: OSTI; NTIS; GPO Dep.

This is a monthly report published by Westinghouse Savannah River Company. Topics discussed in this progress report are: Terrazzo reservoir, Replacement Tritium Facility Final Safety Analysis Report, tritium processing and disposal, separation processes, environmental effects and future impacts, laboratory performance evaluation, groundwater characterization, mixed waste management facility, Raman Spectroscopy, waste processing, Defense Waste Processing Facility, mercury recycling, off-gas components testing, incineration facility blowdown solidification, and weld residual stress minimization study.

21040 (WSRC-TR–93-327) **Waste Management Fault Tree Data Bank (WM): 1992 status report.** Baughman, D.F.; Hang, P.; Townsend, C.S. Westinghouse Savannah River Co., Aiken, SC (United States). 30 Aug 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013654. Source: OSTI; NTIS; INIS; GPO Dep.

The Risk Assessment Methodology Group (RAM) of the Nuclear Process Safety Research Section (NPSR) maintains a compilation of incidents that have occurred in the Waste Management facilities. The Waste Management Fault Tree Data Bank (WM) contains more than 35,000 entries ranging from minor equipment malfunctions to incidents with significant potential for injury or contamination of personnel. This report documents the status of the WM data bank including: availability, training, source of data, search options, and usage, to which these data have been applied. Periodic updates to this memorandum are planned as additional data or applications are acquired.

21041 (WSRC-TR–93-520) **Glass temperatures in free-standing canisters.** Hardy, B.J.; Hensel, S.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94005521. Source: OSTI; NTIS; INIS; GPO Dep.

The waste-forms produced by the Defense Waste Processing Facility (DWPF) are subject to the requirements of the Waste Acceptance Product Specifications (WAPS). The WAPS sets the maximum post cooldown temperature of the waste-form glass at 400°C. This criterion must be satisfied for the ambient conditions and heat generation rates expected for the waste-forms. As part of the work described in task plan, WSRC-RP-93-1177, Rev. 0, a computer model was used to calculate the maximum glass temperatures in free standing wasteforms for a variety of ambient temperatures and heat generation rates.

21042 (WSRC-TR–93-578) **Solubility of plutonium and waste evaporation.** Karraker, D.G. Westinghouse Savannah River Co., Aiken, SC (United States). 22 Oct 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-88SR18036. Order Number DE94013206. Source: OSTI; NTIS; INIS; GPO Dep.

Chemical processing of irradiated reactor elements at the Savannah River Site separates uranium, plutonium and fission products; fission products and process-added chemicals are mixed with an excess of NaOH and discharged as a basic slurry into large underground tanks for temporary storage. The slurry is composed of base-insoluble solids that settle to the bottom of the tank; the liquid supernate contains a mixture of base-soluble chemicals–nitrates, nitrites aluminate, sulfate, etc. To conserve space in the waste tanks, the supernate is concentrated by evaporation. As the evaporation proceeds, the solubilities of some components are exceeded, and these species crystallize from solution. Normally, these components are soluble in the hot solution discharged from the waste tank evaporator and do not crystallize until the solution cools. However, concern was aroused at West Valley over the possibility that plutonium would precipitate and accumulate in the evaporator, conceivably to the point that a nuclear accident was possible. There is also a concern at SRS from evaporation of sludge washes, which arise from washing the base-insoluble solids

('sludge') with ca. 1M NaOH to reduce the Al and SO_4^{-2} content. The sludge washes of necessity extract a low level of Pu from the sludge and are evaporated to reduce their volume, presenting the possibility of precipitating Pu. Measurements of the solubility of Pu in synthetic solutions of similar composition to waste supernate and sludge washes are described in this report.

21043 (WSRC-TR–94-031) **2F Evaporator CP class instrumentation uncertainties evaluations.** Hwang, E. Westinghouse Savannah River Co., Aiken, SC (United States). 28 Jan 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011670. Source: OSTI; NTIS; INIS; GPO Dep.

There are two instrumentation systems in the 2F Evaporator facilities (bldg. 242-16F) that are classified as the Critical Protection (CP). They are the Evaporator Pot Temperature instrumentations and Steam Condensate Gamma Monitor. The pot instrumentation consists of two interrelated circuits sharing the same temperature sensor and transducer. They are the high alarm and interlock circuit and the recorder circuit. The gamma monitor instrumentation consists of four interrelated circuits sharing the same scintillation detector. They are the gamma alarm and interlock circuit, failure alarm and interlock circuit, condensate cesium activity recorder circuit, and condensate americium activity recorder circuit. The resulting uncertainties for the instrument circuits are tabulated. (GHH)

21044 (WSRC-TR–94-039) **Life-cycle cost analysis for Foreign Research Reactor, Spent Nuclear Fuel Disposal.** Parks, P.B.; McDonell, W.R.; DuPont, M.E.; Geddes, R.L.; McWhorter, D.L.; Jackson, W.N.; Liutkus, A.S. Westinghouse Savannah River Co., Aiken, SC (United States). 30 Mar 1994. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011171. Source: OSTI; NTIS; INIS; GPO Dep.

A request was made for analysis of disposal of the Foreign Research Reactor-Spent Nuclear Fuel (FRR-SNF). This analysis addresses the life-cycle costs and unit costs for a range of FRR-SNF elements from that which are currently available (6,000 elements) to the bounding case for the EIS (i.e., 15,000 elements). A broad base of fuel forms studied, including direct disposal of multiple elements (e.g., approximately 165 FRR-SNF elements) in a poison canister to disposal of treated SNF in a glass log waste form. This report was prepared by elements of three Westinghouse Savannah River Company (WSRC) Divisions: Economic Development, Nuclear Materials Production, and Engineering and Projects.

21045 (WSRC-TR–94-0112) **User's manual for BINIAC: A computer code to translate APET bins.** Gough, S.T. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012927. Source: OSTI; NTIS; INIS; GPO Dep.

This report serves as the user's manual for the FORTRAN code BINIAC. BINIAC is a utility code designed to format the output from the Defense Waste Processing Facility (DWPF) Accident Progression Event Tree (APET) methodology. BINIAC inputs the accident progression bins from the APET methodology, converts the frequency from occurrences per hour to occurrences per year, sorts the progression bins, and converts the individual dimension character codes into facility attributes. Without the use of BINIAC, this process would be done manually at great time expense. BINIAC was written under the quality assurance control of IQ34 QAP IV-1, revision 0, section 4.1.4. Configuration control is established through the use of a proprietor and a cognizant users list.

21046 (WSRC-TR–94-0127) **Nuclear criticality safety assessment of the low level radioactive waste disposal facility trenches.** Kahook, S.D. Westinghouse Savannah River Co., Aiken, SC (United States). Apr 1994. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012381. Source: OSTI; NTIS; INIS; GPO Dep.

Results of the analyses performed to evaluate the possibility of nuclear criticality in the Low Level Radioactive Waste Disposal Facility (LLRWDF) trenches are documented in this report. The studies presented in this document are limited to assessment of the possibility of criticality due to existing conditions in the LLRWDF. This document does not propose nor set limits for enriched uranium (EU) burial in the LLRWDF and is not a nuclear criticality safety evaluation nor analysis. The calculations presented in the report are Level 2 calculations as defined by the E7 Procedure 2.31, Engineering Calculations.

21047 (Y/WM–179) **The Y-12 Plant No Rad-Added Program for off-site shipment of nonradioactive hazardous waste.** Cooper, K.H. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Mattie, B.K.; Williams, J.L.; Jacobs, D.G.; Roberts, K.A. Oak Ridge Y-12 Plant, TN (United States). 14 Feb 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-940815–2: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94010033. Source: OSTI; NTIS; INIS; GPO Dep.

On May 17, 1991, the US Department of Energy (DOE) issued a directive for DOE operations to cease off-site shipments of nonradioactive hazardous waste pending further clarification and approvals. A DOE Performance Objective for Certification of Non-Radioactive Hazardous Waste was issued in November 1991. In response to these directives, the Waste Management Division of Oak Ridge Y-12 Plant, with assistance from Roy F. Weston, Inc., has developed a No Rad-Added Program to provide small programmatic guidance and a set of procedures, approved by DOE, which will permit hazardous waste to be shipped from the Y-12 Plant to commercial treatment, storage, or disposal facilities after ensuring and certifying that hazardous waste has no radioactivity added as a result of DOE operations. There are serious legal and financial consequences of shipping waste containing radioactivity to an off-site facility not licensed to receive radioactive materials. Therefore, this program is designed with well-defined responsibilities and stringent documentation requirements.

0530 Environmental Aspects

Refer also to citation(s) 20849, 20887, 20921, 20922, 20988, 20992, 20993, 21096, 21106, 22055, 22468, 22548, 22562, 22617, 22721, 22722

21048 (BNWL-D–140) **Letter to P. G. Rhoades, Ref: TWX – MB Biles to T. A. Nemzek, October 18, 1972.** Davidson, J.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Oct 1972. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012869. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD RESERVATION/radioactive effluents; KRYPTON 85/emission; EMISSION; NUCLEAR FACILITIES

21049 (DOE/EM–0147P) **Technology development needs summary, FY 1995.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Development. Mar 1994. 204p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012580. Source: OSTI; NTIS; INIS; GPO Dep.

Historic activities of DOE during the period of nuclear weapons development, and disposal practices of that time, resulted in the discharge of chemical and radioactive materials to the environment at many DOE facilities and sites. DOE has now focused a major technical effort on mitigating the effects of those discharges through an environmental restoration program. Since this could lead to prohibitive costs if conventional technology is applied for remedial action, a national program will be initiated to develop and demonstrate faster, better, cheaper, and safer means of restoring the DOE sites to conditions that will meet state and federal environment regulations. Key elements of the initiative are the Integrated Programs and Integrated Demonstrations, which work together to identify possible solutions to major environmental problems. Needed statements are given for the following programs: mixed waste landfill, uranium in soils, VOC-arid, decontamination and decommissioning of facilities, buried waste, characterization/monitoring/sensor technology, mixed waste, in situ remediation,

efficient separations/processing, minimum additive waste stabilization, supercritical water oxidation. A section on how to get involved is included.

21050 (DOE/RL–92-28-Rev.1) **Columbia River Impact Evaluation Plan.** Weiss, S.G. USDOE Richland Operations Office, WA (United States). Mar 1994. 19p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013010. Source: OSTI; NTIS; INIS; GPO Dep.

A preliminary impact evaluation was conducted to assess the adequacy of existing data and proposed data collection programs for evaluating cumulative health and environmental impacts to the Columbia River due to past practices at the Hanford Site. The results of this evaluation were used to develop this plan to ensure collection of sufficient data for adequate characterization of the Columbia River along the 100 Area for CERCLA purposes. The evaluation used to develop the plan is not a risk assessment; the plan presented here is only a mechanism to collect additional data to support a future risk assessment.

21051 (DOE/RL–93-56-4) **Quarterly report of RCRA groundwater monitoring data for period October 1, 1993–December 31, 1993.** Jungers, D.K. Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 474p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012934. Source: OSTI; NTIS; GPO Dep.

Hanford Site interim-status groundwater monitoring projects are conducted as either background, indicator parameter evaluation, or groundwater quality assessment monitoring programs as defined in the Resource Conservation and Recovery Act of 1976 (RCRA); and Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, as amended (40 Code of Federal Regulations [CFR] 265). Compliance with the 40 CFR 265 regulations is required by the Washington Administrative Code (WAC) 173-303. This report contains data from Hanford Site groundwater monitoring projects. Westinghouse Hanford Company (WHC) manages the RCRA groundwater monitoring projects for federal facilities on the Hanford Site. Project management, specifying data needs, performing quality control (QC) oversight, managing data, and preparing project sampling schedules are all parts of this responsibility. Pacific Northwest Laboratory (PNL) administers the contract for analytical services and provides groundwater sampling services to WHC for the RCRA groundwater monitoring program. This quarterly report contains data received between November 20 and February 25, 1994, which are the cutoff dates for this reporting period. This report may contain not only data from the October through December quarter but also data from earlier sampling events that were not previously reported.

21052 (HW–14742-Del.) **Extraneous radioactive particles.** Parker, H.M. Hanford Works, Richland, WA (United States). 14 Oct 1949. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007884. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Health Instrument Divisions have been conducting studies on the atmospheric pollution due to Hanford Works participate contamination in the states of Washington, Oregon, Idaho, and Montana. This is a brief summary of the detection and identification of particles definitely extraneous to the Hanford system, and unequivocally defining the occurrence of an atomic explosion. These findings should be of interest to the Atomic Energy Commission and the National Military Establishment.

21053 (ORNL/TM–12338/R1) **Report on the biological monitoring program at Paducah Gaseous Diffusion Plant December 1990 to November 1992.** Kszos, L.A. (ed.). Oak Ridge National Lab., TN (United States). Mar 1994. 172p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013079. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4059.

On September 23, 1987, the Commonwealth of Kentucky Natural Resources and Environmental Protection Cabinet issued an Agreed Order that required the development of a Biological Monitoring Program (BMP) for the Paducah Gaseous Diffusion Plant (PGDP). Beginning in fall 1991, the Environmental Sciences Division (ESD) at Oak Ridge National Lab (ORNL) added data collection and report preparation to its responsibilities for the PGDP BMP. The BMP has been continued because it has proven to be extremely valuable in identifying those effluents with the potential for adversely affecting instream fauna, assessing the ecological health of receiving streams, guiding plans for remediation, and protecting human health. In September 1992, a renewed permit was issued which requires toxicity monitoring of continuous and intermittent outfalls on a quarterly basis. The BMP for PGDP consists of three major tasks: (1) effluent and ambient toxicity monitoring, (2) bioaccumulation studies, and (3) ecological surveys of stream communities. This report includes ESD/ORNL activities occurring from December 1990 to November 1992.

21054 (PNL-SA–24094) **Selective, high-energy beta scintillation sensor for real-time, in situ characterization of uranium-238 and strontium-90.** Schilk, A.J.; Abel, K.H.; Brown, D.P.; Thompson, R.C.; Knopf, M.A.; Hubbard, C.W. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940401–11: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94013325. Source: OSTI; NTIS; INIS; GPO Dep.

A novel scintillating-fiber sensor for detecting high-energy beta particles has been designed and built at the Pacific Northwest Laboratory to characterize ^{238}U and ^{90}Sr in surface soils. High-energy betas generate unique signals as they pass through multiple layers of scintillating fibers that make up the active region of the detector. Lower-energy beta particles, gamma rays, and cosmic-ray-generated particles comprise the majority of the background interferences. The resulting signals produced by these latter phenomena are effectively discriminated against due to the combination of the sensor's multi-layer configuration and its interlayer coincidence/anti-coincidence circuitry.

21055 (RFP-ADD–0026) **Analysis of offsite emergency planning zones (EPZs) for the Rocky Flats Plant: Phase 3, Sitewide spectrum-of-accidents and bounding EPZ analysis.** Petrocchi, A.J.; Smith, M.L. EG and G Rocky Flats, Inc., Golden, CO (United States). 25 Oct 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90RF62349. Order Number DE94013411. Source: OSTI; NTIS; GPO Dep.

This Charter provides the basis for a cooperative, interagency effort to conduct Phase III of the "Analysis of Offsite Emergency Planning Zones (EPZs) for the Rocky Flats Plant" Project. The purpose of this Charter is to define the Project and establish an Oversight Committee management structure together with responsibilities and commitments. This Charter establishes a commitment on the part of the signing agencies to participate in a Phase III EPZ analysis to refine existing EPZs for the Rocky Flats Plant. These agencies agree to commit resources to this Project to fulfill their identified roles. The specific types and levels of resources committed by each agency will be determined as part of the Project planning process. This Charter does not commit any agency to any specific level of effort or resources. It does, however, commit these agencies to support the Phase III analysis to completion.

21056 (RMI-SER–1993) **Site environmental report for the RMI Titanium Company Extrusion Plant, Ashtabula, Ohio: Annual report, 1 January–31 December 1993.** RMI Co., Ashtabula, OH (United States). [1993]. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-93CH10555. Order Number DE94013414. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents information describing the environmental protection program of the RMI Decommissioning Project (RMIDP), and the data obtained from the implementation of the program in 1993. The program involves ongoing environmental surveillance and monitoring campaigns. The program is conducted based upon guidance from the EPA, NRC, and the DOE. The data obtained from the program are compared with environmental standards and requirements, and highlight significant efforts that have been made to achieve compliance with these standards. This report follows the guidance described in DOE order 5400.1, and presents data on radionuclide and chemical constituents in environmental media at and near the site which include air, surface water, groundwater,

soil, and stream sediments. It also describes the potential effects of facility operations on the public. Additionally, this report contains an Environmental Compliance Summary outlining specific environmental compliance activities conducted by RMI.

21057 (UCRL-CR–111478) **Basis for seismic provisions of DOE-STD-1020.** Kennedy, R.C. (RPK Structural Mechanics Consulting, Yorba Linda, CA (United States)); Short, S.A. Lawrence Livermore National Lab., CA (United States); Brookhaven National Lab., Upton, NY (United States); RPK Structural Mechanics Consulting, Yorba Linda, CA (United States); EQE International, Inc., San Francisco, CA (United States). Apr 1994. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ; AC02-76CH00016. (BNL–52418). Order Number DE94010898. Source: OSTI; NTIS; GPO Dep.

DOE-STD-1020 provides for a graded approach for the seismic design and evaluation of DOE structures, systems, and components (SSC). Each SSC is assigned to a Performance Category (PC) with a performance description and an approximate annual probability of seismic-induced unacceptable performance, P_F. The seismic annual probability performance goals for PC 1 through 4 for which specific seismic design and evaluation criteria are presented. DOE-STD-1020 also provides a seismic design and evaluation procedure applicable to achieve any seismic performance goal annual probability of unacceptable performance specified by the user. The desired seismic performance goal is achieved by defining the seismic hazard in terms of a site-specified design/evaluation response spectrum (called herein, the Design/Evaluation Basis Earthquake, DBE). Probabilistic seismic hazard estimates are used to establish the DBE. The resulting seismic hazard curves define the amplitude of the ground motion as a function of the annual probability of exceedance P_H of the specified seismic hazard. Once the DBE is defined, the SSC is designed or evaluated for this DBE using adequately conservative deterministic acceptance criteria. To be adequately conservative, the acceptance criteria must introduce an additional reduction in the risk of unacceptable performance below the annual risk of exceeding the DBE. The ratio of the seismic hazard exceedance probability P_H to the performance goal probability P_F is defined herein as the risk reduction ratio. The required degree of conservatism in the deterministic acceptance criteria is a function of the specified risk reduction ratio.

21058 (WHC-SA–2162) **Qualitative evaluation of heavy metals in soils using portable XRF instruments.** McCain, R.G. Westinghouse Hanford Co., Richland, WA (United States). Oct 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9311122–2: Superfund 14, Washington, DC (United States), 30 Nov - 2 dec 1993). Order Number DE94013250. Source: OSTI; NTIS; INIS; GPO Dep.

Portable isotope-source energy dispersive x-ray fluorescence (XRF) analyzers can provide rapid on site screening for heavy metals in soils. Their use generally involves empirical calibration to a suite of representative soil samples spiked with a range of concentrations of the analytes of interest. In most cases, only a limited number of analytes can be measured with this approach, because of constraints imposed by the operational software and costs associated with preparing the calibration suite. A simple approach is described that provides a qualitative indication of anomalous concentrations of heavy metals based on numeric comparison of gross count rates to background values. This approach can rapidly identify contaminated soils and does not depend on a suite of calibration samples. Direct measurements can be made to rapidly map soil contamination without sample collection, and the method can also be applied to other surfaces such as concrete.

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Refer also to citation(s) 20836, 20838, 20842, 20843, 20846, 20849, 20853, 20860, 20861, 20868, 20869, 20874, 20877, 20878, 20883, 20888, 20905, 20927, 20931, 20932, 20940, 20942, 20943, 20945, 20947, 20950, 20955, 20956, 20964, 20981, 20982, 20995, 20996, 20997, 20998, 21000, 21001, 21002, 21003, 21004, 21005, 21006, 21007, 21008, 21010, 21011, 21012, 21015, 21016, 21017, 21020, 21021, 21024, 21025, 21026, 21029, 21034, 21038, 21039, 21046, 21612, 21654, 21696, 22161, 22182, 22209, 22211, 22424, 22555, 22561, 22571, 22583, 22596, 22665, 22727, 22728

21059 (ANL/CHM/PP–77923) **The radiolytic and radiolytically induced gas generation in Hanford waste tanks.** Jonah, C.D.; Meisel, D.; Sauer, M.C. Jr. Argonne National Lab., IL (United States). Chemistry Div. [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012638. Source: OSTI; NTIS; INIS; GPO Dep.

A task force operating in ANL/CHM has been developing a mechanistic understanding of the radiolytic processes that lead to the generation and retention of gases within tanks of radioactive waste at the Hanford site. This chemistry is one of the important factors that must be considered in devising remediation procedures to eliminate the great potential hazard of these tanks. A quantitative description of much of the chemistry involved in the production of H_2 and, to a lesser extent, in the production of N_2O has been achieved. Direct radiolytic generation was experimentally quantified and this new information was utilized in computer modeling to provide predictive capabilities so that changes of chemical composition of various waste tanks under different remediation procedures could be assessed. Oxygen in the waste solutions is effectively consumed upon irradiation and thus is of no concern. The mechanism of the radiolytic degradation of the chelators was established. The end products are simple organic molecules, in particularly, formaldehyde and glyoxylate, that are very efficient in the thermal generation of H_2.

21060 (ANL/ER/PP–75728) **Geophysical surveys integrated in preremedial site investigations for a landfill in New Mexico.** Burton, J. (Argonne National Lab., IL (United States)); McGinnis, L.; Walker, J.; Hoekstra, P.; Blohm, M. Argonne National Lab., IL (United States). [1994]. 21p. Sponsored by New Mexico State Government, Santa Fe, NM (United States). DOE Contract W-31109-ENG-38. Order Number DE94009822. Source: OSTI; NTIS; GPO Dep.

Surface geophysical surveys were integrated in a preremedial site investigative program at a landfill in New Mexico belonging to the Bureau of Land Management. The purpose of this program was not only to conduct the investigation but also to establish a sound technical framework for future site investigations in that geologic and hydrogeologic setting. The emphasis was on identifying initial characterization procedures that would decrease the need for sampling and drilling on a random grid. A prior preliminary assessment and site investigation indicated the presence of some hazardous waste compounds but yielded contradictory information about the locations of trenches and pits.

21061 (CONF-9309139–12) **Laboratory interface in support of Environmental Restoration Programs.** Pardue, G.J. Jr. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. American Society for Quality Control (ASQC) national energy and environmental annual conference; Indian Wells, CA (United States); 19-22 Sep 1993. Order Number DE94013265. Source: OSTI; NTIS; INIS; GPO Dep.

A vital part of quality environmental data resides in the communication between the project and the analytical laboratory. It is essential that the project clearly identify its objectives to the laboratory and that the laboratory understands the scope and limitations of the analytical process. Successful completion of an environmental project must include an aggressive program between project managers and subcontracted Lyrical laboratories. All to often, individuals and organizations tend to deflect errors and failures observed in environmental toward "the other guy". The engineering firm will blame the laboratory, the laboratory will blame the field operation, the field operation will blame the engineering, and everyone will blame the customer for not understanding the true variables in the environmental arena. It is the contention of the authors, that the majority of failures derive from a lack of communication and misunderstanding. Several initiatives can be taken to improve communication and understanding between the various pieces of the environmental data quality puzzle. This presentation attempts to outline mechanisms to improve communication between the environmental project and the analytical laboratory with the intent of continuous quality improvement. Concepts include:

project specific laboratory statements of work which focus on project and program requirements; project specific analytical laboratory readiness reviews (project kick-off meetings); laboratory team workshops; project/program performance tracking and self assessment and promotion of team success.

21062 (CONF-940225–75) **Relationships of radon diffusion coefficient with saturated hydraulic conductivity, fines content and moisture saturation of radon/infiltration barriers for the UMTRA Project.** Li, P.Y. (Morrison-Knudsen Co., Inc., Boise, ID (United States)); Chen, P.K. Jacobs Engineering Group, Inc., Albuquerque, NM (United States). 24 Jan 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL62350. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94008608. Source: OSTI; NTIS; GPO Dep.

The release of ^{222}Radon to the atmosphere is controlled by the rate of its gas transport through earthen materials. Of the many soil-related parameters, radon diffusion coefficient is the key parameter that characterizes this transport. We compared the radon diffusion coefficients measured at the laboratories for the UMTRA Project with simple empirical correlations developed by others. The empirical correlations predict the radon diffusion coefficient based on the fraction of moisture saturation and porosity. One of the more recent correlations agrees reasonably well with the measurements. In addition, by using a series of correlation curves, we studied the empirical relationships of the. radon diffusion coefficient with the saturated hydraulic conductivity, the fines content, and the moisture saturation in soil. The results reveal that a reliable determination of the long-term moisture and porosity is essential in the design of an adequate radon barrier with respect to the radon diffusion coefficient.

21063 (CONF-940225–76) **Statistical evaluation of newly acquired environmental chemical analysis data as a validation tool for the Uranium Mill Tailings Action (UMTRA) Project.** Smith, K. (Weston (Roy F.), Inc. (United States)); Zietz, P.; Minteer, M. USDOE Albuquerque Field Office, NM (United States). Uranium Mill Tailings Remedial Action Project Office. [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL62350. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94008606. Source: OSTI; NTIS; GPO Dep.

A statistical comparison of new data with existing data is being used as an effective tool to augment standard data validation practices on the Department of Energy Uranium Mill Tailings Remedial Action (UMTRA) Project. The automated system allows rapid and reliable detection of anomalies in newly acquired chemical analysis data. Three separate statistical methods have been combined to meet the demanding requirements of environmental chemical data, including age-weighted trend analysis, downweighting of historical anomalies, and iterative recalculation of substitute values for below-detection data.

21064 (CONF-940225–99) **Environmental technology demonstrations at US DOE facilities: Observations regarding the current process and methods for improvement.** Morris, M.I. (Oak Ridge National Lab., TN (United States)); Siegrist, R.L.; Davenport, D.T. Oak Ridge National Lab., TN (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94010130. Source: OSTI; NTIS; GPO Dep.

Technology demonstrations to evaluate innovative processes prior to full-scale implementation is an important element in the overall US Department of Energy (DOE) strategy for the remediation of contaminated sites and/or the treatment of wastes. These demonstrations provide the opportunity to evaluate and compare multiple technologies on a side-by-side basis in order to choose the process that meets the treatment goals most effectively and economically. Technology demonstrations performed at DOE sites entail working under a unique set of constraints that are not typically encountered in the private sector. Not only do the contractors have to meet all applicable federal, state, and local requirements, but also they have the additional constraints of meeting all DOE Orders and specific and sometimes unique site requirements and interfaces. This paper will discuss the past demonstration experience of the authors and provide insight on how researchers and contractors may conduct demonstrations at a DOE facility.

21065 (CONF-940225–109) **Risk assessment applications for determining cleanup limits for uranium in treated and untreated soils.** Armstrong, A.Q. (Oak Ridge National Lab., TN (United States)); Layton, D.W.; Rutz, E.E. Oak Ridge National Lab., TN (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94012322. Source: OSTI; NTIS; INIS; GPO Dep.

Uranium-contaminated soils are present at various locations across the US where uranium was processed for nuclear fuels or atomic weapons. Important issues relative to such contamination include the assessment of potential health risks associated with human exposures to the residual uranium and the determination of safe levels of uranium in soils that have been treated by a given technology. This paper discusses various risk assessment considerations that must be dealt with when developing cleanup limits for uranium in treated and untreated soils. Key issues addressed include alternative land use scenarios, potential exposure pathways, characterization of the bioavailability of uranium compounds in food and water, a brief overview of health risks associated with uranium and its daughter products as well as a summary of considerations for development of risk-based cleanup limits for uranium in soils.

21066 (CONF-940225–110) **Recent progress of the waste processing and disposal projects within the Underground Storage Tank-Integrated Demonstration.** Hunt, R.D. (Oak Ridge National Lab., TN (United States)); McGinnis, C.P.; Cruse, J.M. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94012321. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) Office of Environmental Restoration and Waste Remediation has created the Office of Technology Development (OTD) to provide new and improved remediation technologies for the 1×10^8 gal of radioactive waste in the underground storage tanks (USTs) at five DOE sites. The OTD established and the Underground Storage Tank-Integrated Demonstration (UST-ID) to perform demonstrations, tests, and evaluations on these new technologies before these processes are transferred to the tank sites for use in full-scale remediation of the USTs. The UST-ID projects are performed by the Characterization and Waste Retrieval Program or the Waste Processing and Disposal Program (WPDP). During FY 1994, the WPDP is funding 12 projects in the areas of supernate processing, sludge processing, nitrate destruction, and final waste forms. The supernate projects are primarily concerned with cesium removal. A mobile evaporator and concentrator for cesium-free supernate is also being demonstrated. The sludge projects are emphasizing sludge dissolution and the evaluation of the TRUEX and diamide solvent extraction processes for transuranic waste streams. One WPDP project is examining both supernate and sludge processes in an effort to develop a system-level plan for handling all UST waste. The other WPDP studies are concerned with nitrate and organic destruction as well as subsequent waste forms. The current status of these WPDP projects is presented.

21067 (CONF-940225–114) **Influence of attrition scrubbing, ultrasonic treatment, and oxidant additions on uranium removal from contaminated soils.** Timpson, M.E.; Elless, M.P.; Francis, C.W. Oak Ridge National Lab., TN (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994. Order Number DE94013281. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the Uranium in Soils Integrated Demonstration Project being conducted by the US Department of Energy, bench-scale investigations of selective leaching of uranium from soils at the Fernald Environmental Management Project site in Ohio were conducted at Oak Ridge National Laboratory. Two soils (storage pad soil and incinerator soil), representing the major contaminant

sources at the site, were extracted using carbonate- and citric acid-based lixiviants. Physical and chemical processes were used in combination with the two extractants to increase the rate of uranium release from these soils. Attrition scrubbing and ultrasonic dispersion were the two physical processes utilized. Potassium permanganate was used as an oxidizing agent to transform tetravalent uranium to the hexavalent state. Hexavalent uranium is easily complexed in solution by the carbonate radical. Attrition scrubbing increased the rate of uranium release from both soils when compared with rotary shaking. At equivalent extraction times and solids loadings, however, attrition scrubbing proved effective only on the incinerator soil. Ultrasonic treatments on the incinerator soil removed 71% of the uranium contamination in a single extraction. Multiple extractions of the same sample removed up to 90% of the uranium. Additions of potassium permanganate to the carbonate extractant resulted in significant changes in the extractability of uranium from the incinerator soil but had no effect on the storage pad soil.

21068 (CONF-9403102–1) **Defining the role of risk assessment in the comprehensive environmental response compensation and liability act remedial investigation process at the DOE-OR.** Miller, P.D. (Oak Ridge National Lab., TN (United States)); McGinn, C.W.; White, R.K.; Purucker, S.T.; Redfearn, A. Oak Ridge National Lab., TN (United States). 8 Mar 1994. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Human health risk assessment strategy for the Oak Ridge Reservation; Knoxville, TN (United States); 8 Mar 1994. Order Number DE94010131. Source: OSTI; NTIS; GPO Dep.

Cleanup of hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is a complicated and painstaking process, particularly at facilities with a multitude of individual hazardous waste sites, each having a multitude of chemicals and radonuclides. The US Department of Energy-Oak Ridge, Environmental Restoration Division (DOE-OR/ERD) administers five such facilities which are undergoing environmental cleanup under the CERCLA Remedial Investigation and Feasibility Study (RI/FS) process or the Resource Conservation and Recovery Act (RCRA) investigation process. The nature of the wastes treated, stored, or disposed of at the US DOE-OR sites is heterogeneous and often unknown. The amount of environmental sampling, chemical analysis, and document preparation and review required to support a baseline risk assessment alone at each facility often requires years before arriving at a final Record of Decision. Therefore, there is clearly a need to streamline the investigative and decision processes in order to realize the US Environmental Protection Agency's (EPA) goal of reducing contaminant levels to those that are protective human health and the environment in a timely and cost-effective manner.

21069 (CONF-940406–9) **Screening Risk Evaluation methodology.** Hopper, K.M. (Midwest Technical, Inc., Oak Ridge, TN (United States)). Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on decontamination and decommissioning; Knoxville, TN (United States); 27-29 Apr 1994. Order Number DE94012340. Source: OSTI; NTIS; INIS; GPO Dep.

The Screening Risk Evaluation (SRE) Guidance document is a set of guidelines provided for the uniform implementation of SREs performed on D&D facilities. These guidelines are designed specifically for the completion of the second (semi-quantitative screening) phase of the D&D Risk-Based Process. The SRE Guidance produces screening risk scores reflecting levels of risk through the use of risk ranking indices. Five types of possible risk are calculated from the SRE: current releases, worker exposures, future releases, physical hazards, and criticality. The Current Release Index (CRI) calculates the risk to human health and the environment from ongoing or probable releases within a one year time period. The Worker Exposure Index (WEI) calculates the risk to workers, occupants, and visitors in D&D facilities of contaminant exposure. The Future Release Index (FRI) calculates the risk of future releases of contaminants, after one year, to human health and the environment. The Physical Hazards Index (PHI) calculates the risk-to human health due to factors other than that of contaminants. The index of Criticality is approached as a modifying factor to the entire SRE, due to the fact that criticality issues are strictly regulated under DOE. Screening risk results will be tabulated in matrix form and Total Risk will be calculated (weighted equation) to produce a score on which to base early action recommendations. Other recommendations from the screening risk scores will be made based either on individual index scores or from reweighted Total Risk calculations. All recommendations based on the SRE will be made based on a combination of screening risk scores, decision drivers, and other considerations, determined on a project by project basis. The SRE is the first and most important step in the overall D&D project level decision making process.

21070 (CONF-940406–10) **Dual-arm manipulation module for use in decontamination and decommissioning operations.** Hamel, W.R.; Haley, D.C.; Dixon, W.E. Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on decontamination and decommissioning; Knoxville, TN (United States); 27-29 Apr 1994. Order Number DE94012758. Source: OSTI; NTIS; INIS; GPO Dep.

A dual-arm manipulation module is under development for application in decontamination and decommissioning (D&D) tasks. The development is led by Oak Ridge National Laboratory with support from Sandia National Laboratories, and with university and industry participation. The project is part of the Robotics Technology Development Program funded by the US Department of Energy, Environmental Restoration and Waste Management, Office of Technology Development. The dual-arm module is designed to provide dexterous manipulation capability for remote characterization, decontamination, and dismantlement operations, and the module is reconfigurable to meet various deployment requirements. Remote manipulation capability can benefit D&D activities through reduced worker exposure to both contaminant and industrial hazards. When tasks conditions permit, increased use of robotic features reduce costs by increased efficiency of operation.

21071 (CONF-940433–6) **A negative bioventing feasibility test.** DePaoli, D.W. (Oak Ridge National Lab., TN (United States)); Greene, D.W.; Herbes, S.E.; Walzel, A.D. Oak Ridge National Lab., TN (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Spring meeting of the American Institute of Chemical Engineers; Atlanta, GA (United States); 17-21 Apr 1994. Order Number DE94012653. Source: OSTI; NTIS; INIS; GPO Dep.

A bioventing feasibility test was conducted at a hydrocarbon fuel spill site at Oak Ridge National Laboratory. The soils at this site are generally of low air permeability and are representative of the clayey soils encountered at several Department of Energy sites and throughout the southeastern United States. The tests included an in situ air permeability test and in situ respiration tests at three well where highest soil contamination was measured. The in situ respiration tests showed that there was the potential for significant biodegradation in the soil with adequate oxygenation. The in situ permeability tests indicated that the majority of flow was trough fractures, rather than through the bulk soils. A helium tracer test verified that injected gas flowed directly to the surface through a small number of fractures, with no flow reaching the monitoring wells. These results indicate that oxygen transport to the bulk soils would be severely limited by diffusion, such that bioventing was deemed not feasible for this site. In light of these results, the importance of testing for fracture flow in soils of lower permeability is stressed – whether the technology is bioventing or conventional soil venting.

21072 (DOE/CH–9303) **Applied research and development private sector accomplishments: Final summary report.** Beskid, N.J.; Devgun, J.S.; Zielke, M.M.; Erickson, M.D. Argonne National Lab., IL (United States). Dec 1993. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94007920. Source: OSTI; NTIS; GPO Dep.

Because of the nature of most US Department of Energy (DOE) operations, contamination at DOE sites presents complex problems. DOE sites may have radioactive, hazardous, or mixed contamination. The major contaminants include radionuclides, volatile organic

compounds (VOCs), and heavy metals. The contamination exists in soils, groundwater, and buildings and materials. DOE's special problems in site remediation have created a need for better and less costly technologies. Thus, DOE has implemented several initiatives for developing new technologies. This report describes the results of the first set of procurement contracts in this area. Similar research and development (R&D) activities are currently managed for DOE by the Morgantown Energy Technology Center.

21073 (DOE/DP/70056–H1-Vol.1) **US Department of Energy Defense Programs: Safety survey report: Volume I: Main report.** Pinkston, D. (ed.). Science Applications International Corp., San Diego, CA (United States). Nov 1993. 263p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-92DP70056. (SAIC–93/1181-Vol.1). Order Number DE94011918. Source: OSTI; NTIS; GPO Dep.

The Defense Programs (DP) Office of Engineering and Operations Support (DP-62) requested SAIC to organize and conduct a survey-level evaluation of 27 DP non-reactor nuclear facilities. The purpose of the evaluation was to provide a consistent scoping effort to estimate, with high confidence, bounding accident consequences for hazards associated with DP non-reactor nuclear facilities. The evaluation, designated the Defense Programs Safety Survey, examined a variety of plutonium, uranium, tritium, laboratory, and spent-fuel facilities at the Savannah River Site, Oak Ridge, Pantex, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory. Bounding accidents were defined and source terms generated in accordance with the methodology specified in this report. The methodology was designed to identify accidents generally having an overall frequency of occurrence of one in a million per year or less. As a necessary corollary to the methodology, a consistent airborne release fraction parameter data base was developed for accident analysis at non-reactor nuclear facilities. The airborne release fraction parameter data base has been published as draft DOE Handbook 0013-93. This report presents the results of the bounding consequence evaluations. Radiological doses and potential health effects were estimated using the MELCOR Accident Consequences Code System (MACCS). Screening estimates of maximum toxic chemical exposure potential were made using comparable EPA or commercial dispersion models. For comparison purposes, radiological doses and health effects were also estimated for a nuclear power reactor severe accident using the Safety Survey MACCS parameters. To ensure comparability, the reactor accident selected has an estimated frequency of occurrence equal to or greater than that of the target for the Safety Survey bounding accidents.

21074 (DOE/EM–0142P) **Decommissioning Handbook.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Mar 1994. 529p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012855. Source: OSTI; NTIS; INIS; GPO Dep.

The Decommissioning Handbook is a technical guide for the decommissioning of nuclear facilities. The decommissioning of a nuclear facility involves the removal of the radioactive and, for practical reasons, hazardous materials to enable the facility to be released and not represent a further risk to human health and the environment. This handbook identifies and technologies and techniques that will accomplish these objectives. The emphasis in this handbook is on characterization; waste treatment; decontamination; dismantling, segmenting, demolition; and remote technologies. Other aspects that are discussed in some detail include the regulations governing decommissioning, worker and environmental protection, and packaging and transportation of the waste materials. The handbook describes in general terms the overall decommissioning project, including planning, cost estimating, and operating practices that would ease preparation of the Decommissioning Plan and the decommissioning itself. The reader is referred to other documents for more detailed information. This Decommissioning Handbook has been prepared by Enserch Environmental Corporation for the US Department of Energy and is a complete restructuring of the original handbook developed in 1980 by Nuclear Energy Services. The significant changes between the two documents are the addition of current and the deletion of obsolete technologies and the addition of chapters on project planning and the Decommissioning Plan, regulatory requirements, characterization, remote technology, and packaging and transportation of the waste materials.

21075 (DOE/EM–0149P) **Buried Waste Integrated Demonstration: Technology summary.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Development. Mar 1994. 67p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012772. Source: OSTI; NTIS; INIS; GPO Dep.

The Buried Waste Integrated Demonstration (BWID) supports the applied research, development, demonstration, and evaluation of a suite of advanced technologies that offer promising solutions to the problems associated with the remediation of buried waste. BWID addresses the difficult remediation problems associated with DOE complex-wide buried waste, particularly transuranic (TRU) contaminated buried waste. BWID has implemented a systems approach to the development and demonstration of technologies that will characterize, retrieve, treat, and dispose of DOE buried wastes. This approach encompasses the entire remediation process from characterization to post-monitoring. The development and demonstration of the technology is predicated on how a technology fits into the total remediation process. To address all of these technological issues, BWID has enlisted scientific expertise of individuals and groups from within the DOE Complex, as well as experts from universities and private industry. The BWID mission is to support development and demonstration of a suite of technologies that, when integrated with commercially-available technologies, forms a comprehensive, remediation system for the effective and efficient remediation of buried waste throughout the DOE Complex. BWID will evaluate and validate demonstrated technologies and transfer this information and equipment to private industry to support the Office of Environmental Restoration (ER), Office of Waste Management (WM), and Office of Facility Transition (FT) remediation planning and implementation activities.

21076 (DOE/OR–01-1109) **Environmental Restoration Program project management plan for the DOE Oak Ridge Field Office Major System Acquisition OR-1: Revision 1, Environmental Restoration Program.** Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States); Martin Marietta Energy Systems, Inc., Piketon, OH (United States). Dec 1992. 190p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; AC05-76OR00001. (ORNL/M–2553). Order Number DE94009204. Source: OSTI; NTIS; GPO Dep.

In the early 1940s, the Manhattan Project was conducted in a regulatory and operational environment less sophisticated than today. Less was known of the measures needed to protect human health and safety and the environment from the dangers posed by radioactive and hazardous wastes, and experience in dealing with these hazardous materials has grown slowly. Certain hazards were recognized and dealt with from the beginning. However, the techniques used, though standard practices at the time, are now known to have been inadequate. Consequently, the DOE has committed to an aggressive program for cleaning up the environment and has initiated an Environmental Restoration Program involving all its field offices. The objective of this program is to ensure that inactive and surplus DOE facilities and sites meet current standards to protect human health and the environment. The objective of these activities is to ensure that risks posed to human health and safety and the environment by inactive sites and surplus facilities contaminated with radioactive, hazardous, and/or mixed wastes are either eliminated or reduced to prescribed safe levels. This Project Management Plan for Major System Acquisition OR-1 Project documents, communicates, and contributes to the evolution of, the management organizations, systems, and tools necessary to carry out effectively the long-range complex cleanup of the DOE sites on the Oak Ridge Reservation, and at the Paducah, Kentucky, and Piketon, Ohio, uranium enrichment plants managed by the Department of Energy Oak Ridge Field Office; the cleanup of off-site contamination resulting from past releases; and the Decontamination and Decommissioning of surplus DOE facilities at these installations.

21077 (DOE/OR–01-1226/V2) **Oak Ridge Reservation Federal Facility agreement quarterly report for the Environmental**

Restoration Program, January–March 1994: Volume 2. Oak Ridge National Lab., TN (United States). Apr 1994. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–3574). Order Number DE94014031. Source: OSTI; NTIS; GPO Dep.

This quarterly progress report satisfies requirements for the Environmental Restoration (ER) Program that are specified in the Oak Ridge Reservation (ORR) Federal Facility Agreement (FFA) established between the US Department of Energy (DOE), the US Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC). The reporting period covered herein is January through March 1994 (second quarter of FY 1994). Sections 1.1 and 1.2 provide respectively the milestones scheduled for completion during the reporting period and a list of documents that have been proposed for transmittal during the following quarter but have not been approved as FY 1994 commitments. Section 2 covers significant accomplishments. Section 3 discusses technical status at the Oak Ridge Y-12 Plant, Oak Ridge National Laboratory, Oak Ridge K-25 Site, and Clinch River. Technical oversight and technical programs are also covered. Section 4 covers responds action contractor assignments.

21078 (DOE/OR/21548–436) **Weldon Spring Site environmental report for calendar year 1993: Weldon Springs Site Remedial Action Project.** MK-Ferguson Co., St. Charles, MO (United States); Jacobs Engineering Group, Inc., St. Charles, MO (United States). May 1994. 365p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21548. Order Number DE94013723. Source: OSTI; NTIS; INIS; GPO Dep.

This Site Environmental Report for Calendar Year 1993 describes the environmental monitoring programs at the Weldon Spring Site Remedial Action Project (WSSRAP). The objectives of these programs are to assess actual or potential exposure to contaminant effluents from the project area by providing public use scenarios and dose estimates, to demonstrate compliance with Federal and State permitted levels, and to summarize trends and/or changes in contaminant concentrations from environmental monitoring program. In 1993, the maximum committed dose to a hypothetical individual at the chemical plant site perimeter was 0.03 mrem (0.0003 mSv). The maximum committed dose to a hypothetical individual at the boundary of the Weldon Spring Quarry was 1.9 mrem (0.019 mSv). These scenarios assume an individual walking along the perimeter of the site-once a day at the chemical plant/raffinate pits and twice a day at the quarry-250 days per year. This hypothetical individual also consumes fish, sediment, and water from lakes and other bodies of water in the area. The collective dose, based on an effected population of 112,000 was 0.12 person-rem (0.0012 person-Sv). This calculation is based on recreational use of the August A. Busch Memorial Conservation Area and the Missouri Department of Conservation recreational trail (the Katy Trail) near the quarry. These estimates are below the U.S. Department of Energy requirement of 100 mrem (I mSv) annual committed effective dose equivalent for all exposure pathways. Results from air monitoring for the National Emission Standards for Hazardous Air Pollutants (NESHAPs) program indicated that the estimated dose was 0.38 mrem, which is below the U.S. Environmental Protection Agency (EPA) standard of 10 mrem per year.

21079 (DOE/OR/21949–374) **Colonie Interim Storage Site environmental surveillance report for calendar year 1993.** Bechtel National, Inc., Oak Ridge, TN (United States). Jun 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE94012720. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the results of environmental surveillance activities conducted at the Colonie Interim Storage Site (CISS) during calendar year 1993. It includes an overview of site operations, the basis for radiological and nonradiological monitoring, dose to the offsite population, and summaries of environmental programs at CISS. Environmental surveillance activities were conducted in accordance with the site environmental monitoring plan, which describes the rationale and design criteria for the surveillance program, the frequency of sampling and analysis, specific sampling and analysis procedures, and quality assurance requirements. Appendix A contains a discussion of the nature of radiation, the way it is measured, and common sources of it. The primary environmental guidelines and limits applicable to CISS are given in US Department of Energy (DOE) orders and mandated by six federal acts: the Clean Air Act; the Clean Water Act; the Resource Conservation and Recovery Act (RCRA); the Toxic Substances Control Act; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the National Environmental Policy Act (NEPA). DOE began environmental monitoring of CISS in 1984 when DOE was authorized by Congress through the Energy and Water Development Appropriations Act to conduct a decontamination research and development program at the site. The site was subsequently assigned to DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP).

21080 (DOE/OR/21949–378) **Hazelwood Interim Storage Site environmental surveillance report for calendar year 1993.** Bechtel National, Inc., Oak Ridge, TN (United States). Jun 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE94012719. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the results of environmental surveillance activities conducted at the Hazelwood Interim Storage Site (HISS) during calendar year 1993. It includes an overview of site operations, the basis for monitoring for radioactive and non-radioactive parameters, summaries of environmental program at HISS, a summary of the results, and the calculated hypothetical radiation dose to the offsite population. Environmental surveillance activities were conducted in accordance with the site environmental monitoring plan, which describes the rationale and design criteria for the surveillance program, the frequency of sampling and analysis, specific sampling and analysis procedures, and quality assurance requirements. The US Department of Energy (DOE) began environmental monitoring of HISS in 1984, when the site was assigned to DOE by Congress through the energy and Water Development Appropriations Act and subsequent to DOE's Formerly Utilized Sites Remediation Action Program (FUSRAP). Contamination at HISS originated from uranium processing work conducted at Mallinckrodt Chemical Works at the St. Louis Downtown Site (SLDS) from 1942 through 1957.

21081 (DOE/OR/21949–379) **Niagara Falls Storage Site environmental surveillance report for calendar year 1993.** Bechtel National, Inc., Oak Ridge, TN (United States). Jun 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE94012721. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the results of environmental surveillance activities conducted at the Niagara Falls Storage Site (NFSS) during calendar year 1993. It includes an overview of site operations, the basis for radiological and nonradiological monitoring, a summary of the results, and the estimated dose to the offsite population. Environmental surveillance activities were conducted in accordance with the site environmental monitoring plan, which describes the rationale and design criteria for the surveillance program, the frequency of sampling and analysis, specific sampling and analysis procedures, and quality assurance requirements. NFSS is in compliance with National Emission Standards for Hazardous Air Pollutants (NESHAPs) Subpart H of the Clean Air Act as well as the requirements of the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act. Located in northwestern New York, the site covers 191 acres. From 1944 to the present, the primary use of NFSS has been storage of radioactive residues that were by-products of uranium production. Most onsite areas of residual radioactivity above regulatory guidelines were remediated during the early 1980s. Additional isolated areas of onsite contamination were remediated in 1989, and the materials were consolidated into the waste containment structure in 1991. Remediation of the site has now been completed.

21082 (DOE/RL–94-02) **Hanford Emergency Response Plan.** Wagoner, J.D. USDOE Richland Operations Office, WA (United States). Apr 1994. 181p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013581. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Emergency Response Plan for the US Department of Energy (DOE), Richland Operations Office (RL), incorporates

into one document an overview of the emergency management program for the Hanford Site. The program has been developed in accordance with DOE orders, and state and federal regulations to protect worker and public health and safety and the environment in the event of an emergency at or affecting the Hanford Site. This plan provides a description of how the Hanford Site will implement the provisions of DOE 5500 series and other applicable Orders in terms of overall policies and concept of operations. It should be used as the basis, along with DOE Orders, for the development of specific contractor and RL implementing procedures.

21083 (DOE/RL/10382–1) **Design and use of plasma APC cutting equipment.** Sequoyah Fuels Corp., Oklahoma City, OK (United States). [1994]. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-83RL10382. Order Number DE94011964. Source: OSTI; NTIS; GPO Dep.

This report discusses the use of the plasma arc cutting system in the decommissioning of the Sequoyah Fuels Corporation Plutonium Fuels Fabrication Facility ("The Cimarron Facility"), Crescent, Oklahoma. The system uses a plasma arc cutting torch modified for either manual or automatic operation and adaptable for use in either a normal glove box environment or in one which has been inerted to eliminate potential hazards of flammable or explosive materials. The program to decommission the Cimarron Facility will not be completed for several more years, but sufficient amount of work has been done with the plasma arc cutting system to allow the following conclusions to be drawn: (1) Major cost savings can be realized by the use of plasma arc cutting (rather than the more conventional mechanical methods) for the large amounts of thick stainless steel used for process equipment and glove boxes in a plutonium production facility. These savings are primarily due to the extremely rapid rate at which the plasma arc torch can cut the thick stainless steel. Experience to date has indicated a major reduction in operating man-hours by use of this equipment, even under the most difficult conditions of remote automatic operation in an inert atmosphere. (2) The speed of operation, and the fact that the cutting can be done in a ventilated glove box, markedly increases operator efficiency by eliminating the need for cumbersome protective clothing and decreases potential operator exposure to the hazards of plutonium contamination and gamma radiation.

21084 (EGG-CEE–10883) **Remediation application strategies for depleted uranium contaminated soils at the US Army Yuma Proving Ground.** Vandel, D.S.; Medina, S.M.; Weidner, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1994. 221p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE94010710. Source: OSTI; NTIS; INIS; GPO Dep.

The US Army Yuma Proving Ground (YPG), located in the southwest portion of Arizona conducts firing of projectiles into the Gunpoint (GP-20) firing range. The penetrators are composed of titanium and DU. The purpose of this project was to determine feasible cleanup technologies and disposal alternatives for the cleanup of the depleted uranium (DU) contaminated soils at YPG. The project was split up into several tasks that include (a) collecting and analyzing samples representative of the GP-20 soils, (b) evaluating the data results, (c) conducting a literature search of existing proven technologies for soil remediation, and (0) making final recommendations for implementation of this technology to the site. As a result of this study, several alternatives for the separation, treatment, and disposal procedures are identified that would result in meeting the cleanup levels defined by the Nuclear Regulatory Commission for unrestricted use of soils and would result in a significant cost savings over the life of the firing range.

21085 (FEMP–2340) **Site environmental report summary.** Fernald Environmental Restoration Management Corp., Cincinnati, OH (United States). Fernald Environmental Management Project. 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-92OR21972. Order Number DE94012507. Source: OSTI; NTIS; INIS; GPO Dep.

In this summary of the Fernald 1992 Site Environmental Report the authors will describe the impact of the Fernald site on man and the environment and provide results from the ongoing Environmental Monitoring Program. Also included is a summary of the data obtained from sampling conducted to determine if the site complies with DOE, US Environmental Protection Agency (USEPA), and Ohio EPA (OEPA) requirements. These requirements are set to protect both man and the environment.

21086 (HW–73679) **Critical mass control specification hood 7-A.** Meeker, L.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 May 1962. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011259. Source: OSTI; NTIS; GPO Dep.

Declassified.

Hood 7-A will be used to handle filtrate and miscellaneous aqueous waste streams from the RMC button line. This document defines the critical mass control specifications for hood 7-A.

21087 (LA–12783-MS) **Performance of horizontal versus vertical vapor extraction wells.** Birdsell, K.H.; Roseberg, N.D.; Edlund, K.M. Los Alamos National Lab., NM (United States). Jun 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013643. Source: OSTI; NTIS; INIS; GPO Dep.

Vapor extraction wells used for site remediation of volatile organic chemicals in the vadose zone are typically vertical wells. Over the past few years, there has been an increased interest in horizontal wells for environmental remediation. Despite the interest and potential benefits of horizontal wells, there has been little study of the relative performance of horizontal and vertical vapor extraction wells. This study uses numerical simulations to investigate the relative performance of horizontal versus vertical vapor extraction wells under a variety of conditions. The most significant conclusion that can be drawn from this study is that in a homogeneous medium, a single, horizontal vapor extraction well outperforms a single, vertical vapor extraction well (with surface capping) only for long, linear plumes. Guidelines are presented regarding the use of horizontal wells.

21088 (LA-UR–94-718) **Cleaning up DOE's weapons sites: Issues of organization and management.** Morzinski, J.A. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940876–1: International Ergonomics Association workshop, Toronto (Canada), 15-19 Aug 1994). Order Number DE94009306. Source: OSTI; NTIS; INIS; GPO Dep.

Many Department of Energy facilities across the United States are seriously contaminated with radioactive and other hazardous wastes. Decades of focus on weapons production and inadequate attention to long-term solutions for dealing with those wastes have resulted in tremendous problems. The Department of Energy recognizes the seriousness of those problems and is addressing them. In some cases existing management systems are being used to accomplish the new mission of environmental cleanup, and in other cases new systems have been created to help carry out that mission. Widespread criticism of those efforts to data are evidence that the management systems being used may not be appropriate for the job. In particular, it appears that some management systems aren't producing desired results because they are not well aligned with the people and tasks for whom they are intended, and these issues are discussed in this report.

21089 (LA-UR–94-1361) **Heap leach studies on the removal of uranium from soil: Report of laboratory-scale test results.** Turney, W.R.J.R.; York, D.A.; Mason, C.F.V.; Chisholm-Brause, C.J.; Dander, D.C.; Longmire, P.A.; Morris, D.E.; Strait, R.K.; Brewer, J.S. Los Alamos National Lab., NM (United States). May 1994. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012885. Source: OSTI; NTIS; GPO Dep.

This report details the initial results of laboratory-scale testing of heap leach that is being developed as a method for removing uranium from uranium-contaminated soil. The soil used was obtained from the site of the Feed Materials Production Center (FMPC) near the village of Fernald in Ohio. The testing is being conducted on a laboratory scale, but it is intended that this methodology will eventually be enlarged to field scale where, millions of cubic meters of uranium-contaminated soil can be remediated. The laboratory scale

experiments show that, using carbonate/bicarbonate solutions, uranium can be effectively removed from the soil from initial values of around 600 ppM down to 100 ppM or less. The goal of this research is to selectively remove uranium from the contaminated soil, without causing serious changes in the characteristics of the soil. It is also hoped that the new technologies developed for soil remediation at FEMP will be transferred to other sites that also have uranium-contaminated soil.

21090 (LA-UR–94-1475) **The Los Alamos National Laboratory Neutron Source Reclamation Program.** Behrens, R.G.; Jones, S.W. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940564–1: National conference on radiation control, Williamsburg, VA (United States), 22-26 May 1994). Order Number DE94011708. Source: OSTI; NTIS; GPO Dep.

Over the past fifty years, the Los Alamos National Laboratory has developed an extensive capability to handle significant quantities of nuclear materials as part of its role in support of DOE Defense Program activities. The goals and objectives of these activities are met through a base program in nuclear materials technology research, development, and demonstration as well as through additional programs (such as the Neutron Source Reclamation Program) aimed at specific, often near-term goals. This base program encompasses (1) plutonium process technology research, development and demonstration activities, (2) technology transfer and offsite technical support, (3) nuclear materials recycle and recovery, and (4) nuclear facility operations and maintenance.

21091 (ORNL–6769) **Proceedings of Soil Decon '93: Technology targeting radionuclides and heavy metals.** Oak Ridge National Lab., TN (United States). Sep 1993. 661p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-9306198–: Soil Decon '93: technology targeting radionuclides and heavy metals, Gatlinburg, TN (United States), 16-17 Jun 1993). Order Number DE94006204. Source: OSTI; NTIS; INIS; GPO Dep.

The principal objective for convening this workshop was to exchange ideas and discuss with scientists and engineers methods for removing radionuclides and/or toxic metals from soils. Over the years there have been numerous symposia, conferences, and workshops directed at soil remediation. However, this may be the first where the scope was narrowed to the removal of radionuclides and toxic metals from soils. The intent was to focus on the separation processes controlling the removal of the radionuclide and/or metal from soil. Its purpose was not intended to be a soil washing/leaching workshop, but rather to identify a variety or combination of processes (chemical, physical, and biological) that can be used in concert with the applicable engineering approaches to decontaminate soils of radionuclides and toxic metals. Abstracts and visual aids used by the speakers of the workshop are presented in this document.

21092 (ORNL/ER–169/S1) **WAG 2 remedial investigation and site investigation site-specific work plan/health and safety checklist for the soil and sediment task: Environmental Restoration Program.** Holt, V.L.; Burgoa, B.B. Oak Ridge National Lab., TN (United States). Dec 1993. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94005996. Source: OSTI; NTIS; INIS; GPO Dep.

This document is a site-specific work plan/health and safety checklist (WP/HSC) for a task of the Waste Area Grouping 2 Remedial Investigation and Site Investigation (WAG 2 RI&SI). Title 29 CFR Part 1910.120 requires that a health and safety program plan that includes site- and task-specific information be completed to ensure conformance with health- and safety-related requirements. To meet this requirement, the health and safety program plan for each WAG 2 RI&SI field task must include (1) the general health and safety program plan for all WAG 2 RI&SI field activities and (2) a WP/HSC for that particular field task. These two components, along with all applicable referenced procedures, must be kept together at the work site and distributed to field personnel as required. The general health and safety program plan is the Health and Safety Plan for the Remedial Investigation and Site Investigation of Waste Area Grouping 2 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (ORNL/ER-169). The WP/HSCs are being issued as supplements to ORNL/ER-169.

21093 (ORNL/RASA–94/1) **Results of the radiological survey at the former Herring-Hall-Marvin Safe Company (3rd floor), 1550 Grand Boulevard, Hamilton, Ohio (HO001).** Murray, M.E.; Johnson, C.A. Oak Ridge National Lab., TN (United States). Mar 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94009135. Source: OSTI; NTIS; GPO Dep.

At the request of the US Department of Energy (DOE), a group from the Oak Ridge National Laboratory conducted a radiological survey at the former Herring-Hall-Marvin Safe Company (third floor), 1550 Grand Boulevard, Hamilton, Ohio (HO001) in August 1993. The purpose of the survey was to determine whether the property was contaminated with radioactive residues, principally ^{238}U, derived from the former Manhattan Engineer District project. The survey included gamma scans; direct and transferable measurements of alpha, beta, and gamma radiation levels; and debris sampling for radionuclide analyses. Results of the survey demonstrated ^{238}U surface contamination in excess of the DOE criteria for surface contamination. The third floor was generally contaminated over 25 percent of its area with isolated spots in the remaining area. Although three isolated spots of contamination were found in areas other than on the third floor (in the same southeastern corner of the facility), they were remediated by sampling. Based on the survey results, this site is recommended for remediation.

21094 (ORNL/TM–12258) **X-231B technology demonstration for in situ treatment of contaminated soil: Contaminant characterization and three dimensional spatial modeling.** West, O.R.; Siegrist, R.L.; Mitchell, T.J.; Pickering, D.A.; Muhr, C.A.; Greene, D.W.; Jenkins, R.A. Oak Ridge National Lab., TN (United States). Nov 1993. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94006112. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4170.

Fine-textured soils and sediments contaminated by trichloroethylene (TCE) and other chlorinated organics present a serious environmental restoration challenge at US Department of Energy (DOE) sites. DOE and Martin Marietta Energy Systems, Inc. initiated a research and demonstration project at Oak Ridge National Laboratory. The goal of the project was to demonstrate a process for closure and environmental restoration of the X-231B Solid Waste Management Unit at the DOE Portsmouth Gaseous Diffusion Plant. The X-231B Unit was used from 1976 to 1983 as a land disposal site for waste oils and solvents. Silt and clay deposits beneath the unit were contaminated with volatile organic compounds and low levels of radioactive substances. The shallow groundwater was also contaminated, and some contaminants were at levels well above drinking water standards. This document begins with a summary of the subsurface physical and contaminant characteristics obtained from investigative studies conducted at the X-231B Unit prior to January 1992 (Sect. 2). This is then followed by a description of the sample collection and analysis methods used during the baseline sampling conducted in January 1992 (Sect. 3). The results of this sampling event were used to develop spatial models for VOC contaminant distribution within the X-231B Unit.

21095 (PNL–9004) **Barrier analogs: Long-term performance issues, preliminary studies, and recommendations.** Waugh, W.J. (Rust Geotech, Inc., Grand Junction, CO (United States). Environmental Sciences Lab.); Chatters, J.C.; Last, G.V.; Bjornstad, B.N.; Link, S.O.; Hunter, C.R. Pacific Northwest Lab., Richland, WA (United States). Feb 1994. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94008622. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy's Hanford Protective Barrier Development Program is funding studies of natural analogs of the long-term performance of waste site covers. Natural-analog studies examine past environments as evidence for projecting the future performance of engineered structures. The information generated by analog studies is needed to (1) evaluate the designs and results of short term experiments and demonstrations, (2) formulate performance-modeling problems that bound expected changes in

waste site environments, and (3) understand emergent system attributes that cannot be evaluated with short-term experiments or computer models. Waste site covers will be part of dynamic environmental systems with attributes that transcend the traits of engineered components. This report discusses results of the previously unreported preliminary studies conducted in 1983 and 1984. These results indicate that analogs could play an important role in predicting the long-term behavior of engineered waste covers. Layered exposures of glacial-flood-deposited gravels mantled with silt or sand that resemble contemporary barrier designs were examined. Bergmounds, another anomaly left by cataclysmic glacial floods, were also examined as analogs of surface gravel.

21096 (PNL–9807) **Technical evaluation of software for gamma-ray logging system.** Stromswold, D.C. Pacific Northwest Lab., Richland, WA (United States). May 1994. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012990. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains results of a technical review of software, identified as LGCALC, that processes data collected by a high-resolution gamma-ray borehole logging system. The software presently operates within Westinghouse Hanford Company, Department of Geosciences, to process data collected by the Radionuclide Logging System. The software has been reviewed for its suitability for processing data to be collected by new high-resolution gamma-ray logging trucks scheduled to begin operational tests within Westinghouse Tank Waste Remediation Systems during 1994. Examination of the program code and hands-on operational tests have shown that this software is suitable for its intended use of processing high-resolution gamma-ray data obtained from borehole logging. Most of the code requires no changes, but in a few limited cases, suggestions have been made to correct errors or improve operation. Section 4 describes these changes. The technical review has confirmed the appropriateness, correctness, completeness, and coding accuracy of algorithms used to process spectral gamma-ray data, leading to a calculation of subsurface radionuclide contaminants. Running the program with test data from calibration models has confirmed that the program operates correctly. Comparisons with hand calculations have shown the correctness of the output from the program, based on known input data. Section 3 describes these tests. The recommended action is to make the near term programming changes suggested in Section 4.1 and then use the LGCALC analysis program with the new high-resolution logging systems once they have been properly calibrated.

21097 (PNL-SA–22421) **Radiological risk guidelines for nonreactor nuclear facilities at the Pacific Northwest Laboratory.** Lucas, D.E.; Ikenberry, T.A. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940312–60: 2. Probabilistic safety assessment and management conference (PSAM), San Diego, CA (United States), 20-24 Mar 1994). Order Number DE94011682. Source: OSTI; NTIS; INIS; GPO Dep.

Radiological risk evaluation guidelines for the public and workers have been developed at the Pacific Northwest Laboratory (PNL) based upon the Nuclear Safety Policy of the US Department of Energy (DOE) established in Secretary of Energy Notice SEN-35-91 (DOE 1991). The DOE nuclear safety policy states that the general public be protected-such that no individual bears significant additional risk to health and safety from the operation of a DOE nuclear facility above the risks to which members of the general population are normally exposed. The radiological risk evaluation guidelines developed at PNL are unique in that they are (1) based upon quantitative risk goals and (2) provide a consistent level of risk management. These guidelines are used to evaluate the risk from radiological accidents that may occur during research and development activities at PNL. A safety analyst uses the frequency of the potential accident and the radiological dose to a given receptor to determine if the accident consequences meet the objectives of the Nuclear Safety Policy.

21098 (PNWD–1983-HEDR-Rev.1) **HEDR modeling approach: Revision 1.** Shipler, D.B.; Napier, B.A. Pacific Northwest Lab., Richland, WA (United States). May 1994. 55p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE94012492. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a revision of the previous Hanford Environmental Dose Reconstruction (HEDR) Project modeling approach report. This revised report describes the methods used in performing scoping studies and estimating final radiation doses to real and representative individuals who lived in the vicinity of the Hanford Site. The scoping studies and dose estimates pertain to various environmental pathways during various periods of time. The original report discussed the concepts under consideration in 1991. The methods for estimating dose have been refined as understanding of existing data, the scope of pathways, and the magnitudes of dose estimates were evaluated through scoping studies.

21099 (RFP–4833) **Analysis of offsite Emergency Planning Zones (EPZs) for the Rocky Flats Plant: Phase 3, Sitewide spectrum-of-accidents and bounding EPZ analysis.** Petrocchi, A.J.; Zimmerman, G.A. EG and G Rocky Flats, Inc., Golden, CO (United States). 14 Mar 1994. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE94013016. Source: OSTI; NTIS; INIS; GPO Dep.

During Phase 3 of the EPZ project, a sitewide analysis will be performed applying a spectrum-of-accidents approach to both radiological and nonradiological hazardous materials release scenarios. This analysis will include the MCA but will be wider in scope and will produce options for the State of Colorado for establishing a bounding EPZ that is intended to more comprehensively update the interim, preliminary EPZ developed in Phase 2. EG&G will propose use of a hazards assessment methodology that is consistent with the DOE Emergency Management Guide for Hazards Assessments and other methods required by DOE orders. This will include hazards, accident, safety, and risk analyses. Using this methodology, EG&G will develop technical analyses for a spectrum of accidents. The analyses will show the potential effects from the spectrum of accidents on the offsite population together with identification of offsite vulnerable zones and areas of concern. These analyses will incorporate state-of-the-art technology for accident analysis, atmospheric plume dispersion modeling, consequence analysis, and the application of these evaluations to the general public population at risk. The analyses will treat both radiological and nonradiological hazardous materials and mixtures of both released accidentally to the atmosphere. DOE/RFO will submit these results to the State of Colorado for the State's use in determining offsite emergency planning zones for the Rocky Flats Plant. In addition, the results will be used for internal Rocky Flats Plant emergency planning.

21100 (RFP–4855) **Safety analyses performed in the Systematic Evaluation Program at Rocky Flats.** Badwan, F.M. (EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant); Persinko, D.; Haga, P.B. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90RF62349. (CONF-9406161–3: Safety analysis working group workshop, Albuquerque, NM (United States), 8-10 Jun 1994). Order Number DE94012366. Source: OSTI; NTIS; GPO Dep.

Structures, systems, and components (SSC) at Rocky Flats were designed and put into operation before current standards and criteria applicable to these SSCs were developed. The purpose of the Systematic Evaluation Program (SEP) at Rocky Flats (RF) is to systematically compare the design of SSCs to current design requirements and assess the differences to assure that a balanced and integrated level of safety is achieved to support long-term operation of the facilities. The SEP is being performed in three phases. Phase 1, selection of technical subjects (topics) and development of evaluation plans is complete. Phase 2, comparison of the design of structures, systems and components to current design requirements (CDR), is in progress. It is being performed in two parts, Phase 2A and Phase 2B. An Integrated Assessment of the recommendations from Phase 2 will be performed in Phase 3. The RF SEP is not necessarily used to bring the RF facilities into compliance with newer standards, but to ensure that the safety issues addressed by current requirements either do not exist, are acceptably addressed by existing designs, or are addressed by

backfit of existing standards into older facilities to the extent appropriate to the concern. For example, administrative controls may provide adequate resolution of issues addressed by design features in more modern facilities.

21101 (SAND–93-4075C) **Probabilistic comparison of alternative characterization technologies at the Fernald Uranium-in-Soils Integrated Demonstration Project.** Rautman, C.A.; McGraw, M.A.; Istok, J.D.; Sigda, J.M.; Kaplan, P.G. Sandia National Labs., Albuquerque, NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940225–16: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94006587. Source: OSTI; NTIS; INIS; GPO Dep.

The performance of four alternative characterization technologies proposed for use in characterization of surficial uranium contamination in soil at the Incinerator and Drum Baling Areas at the Fernald Environmental Management Project in southwestern Ohio has been evaluated using a probabilistic, risk-based decision-analysis methodology. The basis of comparison is to minimize a computed total cost for environmental cleanup. This total-cost-based approach provides a framework for evaluating the trade-offs among remedial investigation, the remedial design, and the risk of regulatory penalties. The approach explicitly recognizes the value of information provided by remedial investigation; additional measurements are only valuable to the extent that the information they provide reduces total cost.

21102 (UCRL-ID–115789) **DOE In Situ Remediation Integrated Program: In situ manipulation technologies subprogram plan.** Yow, J.L. Jr. Lawrence Livermore National Lab., CA (United States). 22 Dec 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012987. Source: OSTI; NTIS; INIS; GPO Dep.

The In Situ Remediation Integrated Program (ISRP) supports and manages a balanced portfolio of applied research and development activities in support of DOE environmental restoration and waste management needs. ISRP technologies are being developed in four areas: containment, chemical and physical treatment, in situ bioremediation, and in situ manipulation (including electrokinetics). the focus of containment is to provide mechanisms to stop contaminant migration through the subsurface. In situ bioremediation and chemical and physical treatment both aim to destroy or eliminate contaminants in groundwater and soils. In situ manipulation (ISM) provides mechanisms to access contaminants or introduce treatment agents into the soil, and includes other technologies necessary to support the implementation of ISR methods. Descriptions of each major program area are provided to set the technical context of the ISM subprogram. Typical ISM needs for major areas of in situ remediation research and development are identified.

21103 (UCRL-JC–115374) **Use of high performance computing to examine the effectiveness of aquifer remediation.** Tompson, A.F.B. (Lawrence Livermore National Lab., CA (United States)); Ashby, S.F.; Falgout, R.D.; Smith, S.G.; Fogwell, T.W.; Loosmore, G.A. Lawrence Livermore National Lab., CA (United States). Jun 1994. 10p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940742–3: Computational methods in water resources, Heidelberg (Germany), 19-22 Jul 1994). Order Number DE94008965. Source: OSTI; NTIS; INIS; GPO Dep.

Large-scale simulation of fluid flow and chemical migration is being used to study the effectiveness of pump-and-treat restoration of a contaminated, saturated aquifer. A three-element approach focusing on geostatistical representations of heterogeneous aquifers, high-performance computing strategies for simulating flow, migration, and reaction processes in large three-dimensional systems, and highly-resolved simulations of flow and chemical migration in porous formations will be discussed. Results from a preliminary application of this approach to examine pumping behavior at a real, heterogeneous field site will be presented. Future activities will emphasize parallel computations in larger, dynamic, and nonlinear (two-phase) flow problems as well as improved interpretive methods for defining detailed material property distributions.

21104 (WHC-EP–0723) **Tank 241-C-106 sampling data requirements developed through the data quality objectives (DQO) process.** Wang, O.S. (Westinghouse Hanford Co., Richland, WA (United States)); Bell, K.E.; Anderson, C.M.; Peffers, M.S.; Pulsipher, B.A.; Scott, J.L. Westinghouse Hanford Co., Richland, WA (United States). Jan 1994. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012393. Source: OSTI; NTIS; INIS; GPO Dep.

The rate of heat generation for tank 241-C-106 at the Hanford Site is estimated at more then 100,000 Btu/h. The heat is generated primarily from the radioactive decay of ^{90}Sr waste that was inadvertently transferred into the tank in the late 1960s. If proper tank cooling is not maintained for this tank, heat-induced structural damage to the tank's concrete shell could result in the release of nuclear waste to the environment. Because of high-heat concerns in January 1991, tank 241-C-106 was designated as a Watch List tank and deemed as a Priority 1 safety issue. Waste Tank Safety Program (WTSP) is responsible for the resolution of this safety issue. Although forced cooling is effective for short term, the long-term resolution for tank cooling is waste retrieval. Single-shell Tank Retrieval Project (Retrieval) is responsible for the safe retrieval and transfer of radioactive waste from tank 241-C-106 to a selected double-shell tank. This data quality objective (DQO) study is an effort to determine engineering and design data needs for WTSP and assist Retrieval in designing contingency action retrieval systems. The 7-step DQO process is a tool developed by the Environmental Protection Agency with a goal of identifying needs and reducing costs. This report discusses the results of two DQO efforts for WTSP and Retrieval. The key data needs to support WTSP are thermal conductivity, permeability, and heat load profile. For the Retrieval support, there are nine and three data needs identified, respectively, for retrieval engineering system design and HVAC system design. The updated schedule to drill two core samples using rotary mode is set for March 1994. The analysis of the sample is expected to be completed by September 1994.

21105 (WHC-SD-EN-TI–173) **Data validation summary report: 300-FF-5 operable unit; Round 6 groundwater.** Hulstrom, L.C. Westinghouse Hanford Co., Richland, WA (United States). 21 Mar 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94010369. Source: OSTI; NTIS; INIS; GPO Dep.

Laboratory data for Sixth Round Groundwater samples collected during the 300-FF-5 Operable Unit Remedial Investigation have been reviewed and validated to ensure that they are of sufficient quality to support decisions regarding further actions to be taken at the 300-FF-5 Operable Unit. Table 1-1 is a summary of the validated samples. This report summarizes the results previously presented to Westinghouse Hanford in a series of Preliminary Quality Assurance Reports (PQAR) for the 300-FF-5 Sixth Round Groundwater samples. In some instances, the data qualifiers originally presented in the PQARs have been changed based upon further review of the data; these changes are highlighted in the text.

21106 (WHC-SD-W306-TI–001-Rev.1) **Radiological and chemical source terms for Solid Waste Operations Complex: Revision 1.** Boothe, G.F. Westinghouse Hanford Co., Richland, WA (United States). 3 Jun 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013577. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this document is to describe the radiological and chemical source terms for the major projects of the Solid Waste Operations Complex (SWOC), including Project W-112, Project W-133 and Project W-100 (WRAP 2A). For purposes of this document, the term "source term" means the design basis inventory. All of the SWOC source terms involve the estimation of the radiological and chemical contents of various waste packages from different waste streams, and the inventories of these packages within facilities or within a scope of operations. The composition of some of the waste is not known precisely; consequently, conservative assumptions were made to ensure that the source term represents a bounding case (i.e., it is expected that the source term would not be exceeded). As better information is obtained on the radiological

and chemical contents of waste packages and more accurate facility specific models are developed, this document should be revised as appropriate. Radiological source terms are needed to perform shielding and external dose calculations, to estimate routine airborne releases, to perform release calculations and dose estimates for safety documentation, to calculate the maximum possible fire loss and specific source terms for individual fire areas, etc. Chemical source terms (i.e., inventories of combustible, flammable, explosive or hazardous chemicals) are used to determine combustible loading, fire protection requirements, personnel exposures to hazardous chemicals from routine and accident conditions, and a wide variety of other safety and environmental requirements.

21107 (WSRC-MS–94-0238) **Remediation of a large contaminated reactor cooling reservoir: Resolving and environmental/regulatory paradox.** Bowers, J.A.: Gladden, J.B. (Westinghouse Savannah River Co., Aiken, SC (United States)); Hickey, H.M.; Jones, M.P.; Mackey, H.E.; Mayer, J.J.; Doswell, A. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940650–2: Annual conference and exposition of the National Association of Environmental Professionals: global strategies for environmental issues, New Orleans, LA (United States), 12-15 Jun 1994). Order Number DE94010822. Source: OSTI; NTIS; GPO Dep.

This paper presents a case study of a former reactor cooling water reservoir, PAR Pond, located Savannah River Site. PAR Pond, a 2640 acre, man-made reservoir was built in 1958 and until 1988, received cooling water from two DOE nuclear production reactors, P and R. The lake sediments were contaminated with low levels of radiocesium (CS-137) and transuranics in the late 1950s and early 1960s because of leaking fuel elements. Elevated levels of mercury accumulated in the sediments from pumping water from the Savannah River to maintain a full pool. PAR Ponds' stability, size, and nutrient content made a significant, unique, and highly studied ecological resource for fish and wildlife populations until it was partially drained in 1991 due to a depression in the downslope of the earthen dam. The drawdown, created 1340 acres of exposed, radioactively contaminated sediments along 33 miles of shoreline. This led US EPA to declare PAR Pond as a CERCLA operable unit subject to remediation. The drawdown also raised concerns for the populations of aquatic plants, fish, alligators, and endangered species and increased the potential for off-site migration of contaminated wildlife from contact with the exposed sediments. Applicable regulations, such as NEPA and CERCLA, require wetland loss evaluations, human health and ecological risk assessments, and remediation feasibility studies. DOE is committed to spending several million dollars to repair the dam for safety reasons, even though the lake will probably not be used for cooling purposes. At the same time, DOE must make decisions whether to refill and expend additional public funds to maintain a full pool to reduce the risks defined under CERCLA or spend hundreds of millions in remediation costs to reduce the risks of the exposed sediments.

21108 (WSRC-MS–94-0324) **A petroleum contaminated soil bioremediation facility.** Lombard, K.; Hazen, T. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940815–15: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013288. Source: OSTI; NTIS; INIS; GPO Dep.

The amount of petroleum contaminated soil (PCS) at the Savannah River site (SRS) that has been identified, excavated and is currently in storage has increased several fold during the last few years. Several factors have contributed to this problem: (1) South Carolina Department of Health ad Environmental control (SCDHEC) lowered the sanitary landfill maximum concentration for total petroleum hydrocarbons (TPH) in the soil from 500 to 100 parts per million (ppm), (2) removal and replacement of underground storage tanks at several sites, (3) most recently SCDHEC disallowed aeration for treatment of contaminated soil, and (4) discovery of several very large contaminated areas of soil associated with leaking underground storage tanks (LUST), leaking pipes, disposal areas, and spills. Thus, SRS has an urgent need to remediate large quantities of contaminated soil that are currently stockpiled and the anticipated contaminated soils to be generated from accidental spills. As long as we utilize petroleum based compounds at the site, we will continue to generate contaminated soil that will require remediation.

21109 (WSRC-RP–94-1641-TL-Rev.1) **Hazards analyses of hydrogen evolution and ammonium nitrate accumulation in DWPF – Revision 1.** Holtzscheiter, E.W. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013287. Source: OSTI; NTIS; INIS; GPO Dep.

This revision consists of two reports, the first of which is an analysis of potential ammonium nitrate explosion hazards in the DWPF (Defense Waste Processing Facility). Sections describe the effect of impurities (organic and inorganic (chlorides, chromates, metals and oxides)); the consequences of a hydrogen deflagration or detonation; the role of confinement; the action of heat on ammonium nitrate; the thermal decomposition of ammonium nitrate; the hazard of spontaneous heating; and the explosive decomposition of ammonium nitrate. The second report, Hazard analysis of hydrogen evolution in DWPF: Process vessels and vent system for the late wash/nitric acid flowsheet, contains a description of a revised model for hydrogen generation based on the late wash/nitric acid process. The second part of the report is a sensitivity analysis of the base case conditions and the hydrogen generation model.

21110 (WSRC-TR–94-046) **2F and 2H evaporator loop evaluation closure report.** Bates, W.F. Westinghouse Savannah River Co., Aiken, SC (United States). 28 Jan 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94010817. Source: OSTI; NTIS; GPO Dep.

As a result of the Concentrate Transfer System (CTS) tank ventilation system contamination event, a task team was formed to evaluate instrument loops associated with waste reduction equipment. During the event a conductivity probe designed to provide an alarm and initiate an interlock failed to respond to the presence of liquid. An investigation revealed that the probe had become disconnected from the loop. The daily functional check of the conductivity probe circuit only tested the circuit continuity from the ventilation unit to the control room and did not actually test the probe. To test the continuity, a test switch was used to simulate the conducting probe. Because the functional check did not test each part of the loop, the test could be satisfactorily completed even though the probe itself was inoperable. The function of the task team was to develop a list of loops and interlocks prioritized by importance and likelihood of similar failure. The team evaluated the associated loop calibration and functional test procedures to verify that they are adequate to ensure loop performance on a periodic frequency. This report documents the evaluation findings and associated actions required prior to startup of the 2F and 2H evaporators.

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Refer also to citation(s) 20805, 20817, 20829, 20832, 21004, 21005, 21318, 21329, 21920, 22375

21111 (DOE/RL/10382–2) **Technical recommendations in the design and operation of a plutonium fuel fabrication facility to facilitate decontamination and decommissioning.** Sequoyah Fuels Corp., Oklahoma City, OK (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-83RL10382. Order Number DE94011965. Source: OSTI; NTIS; GPO Dep.

Sequoyah Fuels Corporation (formerly Kerr-McGee Nuclear Corporation) is in the process of decontaminating and decommissioning the Cimarron Plutonium Facility. This facility was designed to produce mixed oxide $(Pu\text{-}U)O_2$ fuel using the co-precipitation process. This report is intended to address three topics: (1) identify problem areas which were revealed during the first phase of the decontamination and decommissioning (D&D) effort which could have been minimized by use of different design criteria; (2) provide

recommendations which would have minimized Pu hold-up or made non-destructive assay (NDA) for inventory more accurate and less difficult; and (3) identify the limitations of the current NDA equipment being used at the Cimarron Plutonium Facility. The major problem areas uncovered to date and possible resolutions are identified.

21112 (DOE/RL/10382–4) **Nondestructive assay (NDA) techniques and procedures.** Sequoyah Fuels Corp., Oklahoma City, OK (United States). [1994]. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-83RL10382. Order Number DE94011967. Source: OSTI; NTIS; GPO Dep.

Report No. 4 is precursory to Report No. 5 "Determination of the Quantity and Locations of the Pu Currently Retained in the Cimarron Fuel Plant Systems" which will be presented upon completion of the decontamination of the Cimarron Plutonium Fuel Fabrication Facility. This report presents the Non-Destructive Assay (NDA) procedures which were developed and used by Sequoyah Fuels Corporation (successor to Kerr-McGee Nuclear Corporation) to measure equipment hold-up of plutonium materials for inventory purposes during operation of the plant. These procedures are also used to measure plutonium contamination on the equipment removed from the Material Balance Areas (MBA's) during final decontamination. Report No. 5 will compare the measurements taken during this final decontamination period to previous inventory hold-up measurements, the date will be statistically analyzed, and a long-term assessment of the performance of the NDA equipment will be described.

21113 (DOE/RL/10382–5) **Determination of the quantity and locations of the plutonium retained in the Cimarron fuel plant systems.** Sequoyah Fuels Corp., Oklahoma City, OK (United States). [1994]. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-83RL10382. Order Number DE94011968. Source: OSTI; NTIS; GPO Dep.

In late 1975, Sequoyah Fuels Corporation (SFC) announced its intention to suspend operations of its Cimarron Plutonium Fuel Fabrication Facility and to place the Facility in a standby status pending development of further activities. SFC, using non-destructive assay (NDA) measurement techniques, measured the residual plutonium held-up in the plant process equipment to establish a standby inventory hold-up baseline. The NRC's Office of Inspection and Enforcement assembled a team of various government experts that independently measured the plutonium hold-up, using NDA techniques. In 1979, SFC elected to decontaminate the plutonium operation for purposes of decommissioning the site and terminating the NRC license. Care was taken throughout the decontamination program to accurately measure the plutonium content and identify the origin of over 28,000 individual packages of contaminated equipment removed from the plant. The final measurement data for these smaller packages were compared with the results of the 1976 baseline measurement program. This report compares the results of the 1976 baseline inventory data and the NRC team's data with the final measurement data obtained during the decontamination and decommissioning effort.

21114 (HW–70728) **Measurement procedures for purified birch.** Buckingham, J.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Aug 1961. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010537. Source: OSTI; NTIS; GPO Dep.

Declassified.

Since start-up of the neptunium recovery and purification program at HAPO, the neptunium-has been subjected to the following process steps: Production of crude neptunium nitrate by the Redox and Purex plants; Production of purified neptunium nitrate, using an anion exchange process, in research and development facilities operated by CPD's Process Chemistry Operation; Production of neptunium oxide (NpO_2) by Process Chemistry. Mixing the NpO_2 powder with aluminum powder and incorporation in an aluminum-clad-target element, done by the Plutonium Metallurgy Operation of Hanford Laboratories; and Irradiation of the target elements in the Savannah River reactors; and Chemical reprocessing of the irradiated target elements at Savannah River to recover the desired plutonium-238 and the unconverted neptunium. As frequently happens to between-contractor transfers, neptunium material balances between Hanford's NpO_2 and Savannah River's recovered neptunium have sometimes been poorer than expected. Because of wide spread interest in this problem, it was deemed desirable to put on record a description of the measurement techniques which have been used at Hanford for NpO_2 and the improvements which have been made in the analytical methods. The measurement methods used for purified nitrate are also described.

21115 (IAEA-INFCIRC–437) **Communications dated 18 and 19 March 1994 received from the permanent mission of the Democratic People's Republic of Korea to the International Atomic Energy Agency.** International Atomic Energy Agency, Vienna (Austria). 14 Apr 1994. 63p. (In Arabic, Chinese, English, French, Russian, Order Number DE94626617. Source: OSTI; NTIS (US Sales Only); INIS.

Texts of the following communications received from the Permanent Mission of the Democratic People's Republic of Korea, concerning IAEA safeguards inspections, are being circulated to all Member States of the Agency at the Request of the Permanent Mission of the Democratic People's Republic of Korea.

21116 (IAEA-INFCIRC–439) **Communique dated 31 March 1994 by the Greek Presidency on behalf of the European Union.** International Atomic Energy Agency, Vienna (Austria). 14 Apr 1994. 12p. (In Arabic, English, Spanish, French, Russian, Order Number DE94626618. Source: OSTI; NTIS (US Sales Only); INIS.

Text of the Communique of 31 March 1994 of the Greek Presidency on behalf of the European Union on the nuclear problem in the Democratic People's Republic of Korea is being brought to the attention of all Member States of the International Atomic Energy Agency at the request of the Charge d'Affaires a.i. of the Permanent Mission of Greece.

21117 (INIS-JP–018, pp. 1156-1162) **Inspection of packages and loadings before transport of nuclear fuel materials.** Kobayashi, S. (Nuclear Safety Technology Center, Tokyo (Japan)); Igarashi, K.; Kinoshita, M.; Hirata, M. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

Since the commencement of inspection in 1988, NUSTEC has carried out inspections of packages for Type A packages by documents, and inspections of packages and transport methods for Type B packages on the departure spot. Except for confirmations carried out by the government, each year NUSTEC has been performing more than 200 confirmations for Type A packages and more than 10 confirmations for Type B packages. The number of packages and the quantity of uranium transported have a tendency to increase with years. (J.P.N.).

21118 (NBL–328) **New Brunswick Laboratory progress report, October 1992–September 1993.** USDOE New Brunswick Lab., Argonne, IL (United States). Apr 1994. 73p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94011942. Source: OSTI; NTIS; GPO Dep.

The mission of the New Brunswick Laboratory of the US Department of Energy (DOE) is to provide and maintain a nuclear material measurements and standards laboratory as a technical response to DOE's statutory responsibility to assure the safeguarding of nuclear materials. This report summarizes the mission-fulfilling activities of the New Brunswick Laboratory for the period of October 1992 through September 1993.

21119 (ORNL/TM–12697) **Vegetation and soil sampling for detection of enrichment facilities.** Smith, D.H. Oak Ridge National Lab., TN (United States). Jun 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013405. Source: OSTI; NTIS; GPO Dep.

The concept of being able to detect clandestine nuclear operations rests on the fact that they invariably lose material characteristic of the process to the environment. This material can be collected and characterized using highly sensitive analytical techniques. The extent to which these signatures penetrate the environment depends on the type of process and the care taken at the facility to control losses. An enrichment facility that uses UF_6, a gas, will tend to lose more than a reactor because gases are harder to contain then solids. Any nuclear facility, like industrial processes everywhere, loses some characteristic material to the environment. The issues involved in acquiring environmental samples from around nuclear facilities are discussed, with the primary application being safeguards. Sampling plans, sample acquisition, analytical techniques, and data interpretation are described.

21120 (PNL-SA–22838) **Volume calibration for nuclear materials control: ANSI N15.19-1989 and beyond.** Liebetrau, A.M. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 15p. Sponsored by International Atomic Energy Agency, Vienna (Austria). DOE Contract AC06-76RL01830. (CONF-940307–28: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94011231. Source: OSTI; NTIS; INIS; GPO Dep.

Since the last IAEA International Safeguards Symposium, a revised standard for volume calibration methodology was issued in the United States. Because the new standard reflects the advent of high-precision volume measurement technology, it is significantly different from the earlier standard which it supersedes. The new standard outlines a unified data standardization model that applies to process tanks equipped with differential pressure measurement systems for determining liquid content. At the heart of the model is an algorithm to determine liquid height from pressure measurements that accounts for the major factors affecting the accuracy of those measurements. The standardization model also contains algorithms that adjust data from volumetric and gravimetric provers to a standard set of reference conditions. A key component of the standardization model is an algorithm to take account of temperature-induced dimensional changes in the tank. Improved methods for the statistical treatment of calibration data have also appeared since the last Safeguards Symposium. A statistical method of alignment has been introduced that employs a least-squares criterion to determine "optimal" alignment factors. More importantly, a statistical model has been proposed that yields plausible estimates of the variance of height volume measure-ments when significant run-to-run differences are present in the calibration data. The new standardization model and statistical methods described here are being implemented in a portable, user-friendly software program for use by IAEA inspectors and statisticians. Perhaps these methods will eventually find their way into appropriate international standards.

21121 (SAND–93-2632C) **Panoramic imaging perimeter sensor design and modeling.** Pritchard, D.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9403103–1: 1994 infrared information symposium on passive sensors infrared information, Albuquerque, NM (United States), 14-16 Mar 1994). Order Number DE94009283. Source: OSTI; NTIS; GPO Dep.

This paper describes the conceptual design and preliminary performance modeling of a 360-degree imaging sensor. This sensor combines automatic perimeter intrusion detection with immediate visual assessment and is intended to be used for fast deployment around fixed or temporary high-value assets. The sensor requirements, compiled from various government agencies, are summarized. The conceptual design includes longwave infrared and visible linear array technology. An auxiliary millimeter-wave sensing technology is also considered for use during periods of infrared and visible obscuration. The infrared detectors proposed for the sensor design are similar to the Standard Advanced Dewar Assembly Types Three A and B (SADA-IIIA/B). An overview of the sensor and processor is highlighted. The infrared performance of this sensor design has been predicted using existing thermal imaging system models and is described in the paper. Future plans for developing a prototype are also presented.

21122 (UCRL-ID–106454-94-2) **Lawrence Livermore National Laboratory safeguards and security quarterly progress report to the US Department of Energy: Quarterly report.** Davis, G.; Mansur, D.L.; Ruhter, W.D.; Steele, E.; Strait, R.S. Lawrence Livermore National Lab., CA (United States). Apr 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012390. Source: OSTI; NTIS; GPO Dep.

The Safeguards Technology Program (STP) is a program in LLNL's Nuclear Chemistry Division that develops advanced, nondestructive-analysis (NDA) technology for measurement of special nuclear materials. Our work focuses on R&D relating to x- and gamma-ray spectrometry techniques and to the development of computer codes for interpreting the spectral data obtained by these techniques. A review of the Safeguards Technology Program at LLNL by representatives of the Department of Energy Office of Safeguards and Security and Office of Research was conducted via teleconference on March 4, 1994. Objectives, milestones, and recent accomplishments were presented for each of the four LLNL tasks in NDA, and plans to address user needs in these NDA areas were discussed. An informal presentation on the LLNL Safeguards Technology Program was presented to the JOWOG-30 meeting at the Los Alamos National Laboratory on March 10, 1994. The JOWOG meetings bring together representatives from Laboratories in the DOE complex, as well as their counterparts from the United Kingdom. Within JOWOG-30 a variety of topics are discussed, including NDA and its various applications within the U.S. and U.K. complexes.

0560 Legislation and Regulations

Refer also to citation(s) 20840, 20879, 20880, 20881, 20882, 20896, 21339, 22694, 23302

21123 (IAEA-INFCIRC-436) **Communications dated 15 and 22 March 1994 received from the permanent mission of South Africa to the International Atomic Energy Agency.** International Atomic Energy Agency, Vienna (Austria), 14 Apr 1994. 18p. (in Arabic, Chinese, English, French, Russian, Order Number DE94626616. Source: OSTI; NTIS (US Sales Only); INIS.

The Director General received notes verbales dated 15 and 22 March 1994 from the Permanent Mission of South Africa providing information on the nuclear export policies and practices of the Government of South Africa. These notes verbales contain, in their attachments, copies of the relevant legislation and other documentation pertaining to South Africa's policy to act in accordance with the provisions of INFCIRC/254/Rev.1/Part 1 and INFCIRC/254/Rev.1/Part 1/Mod.1 and INFCIRC/254/Rev.1/Part 2 as amended. The documents are available on request from the Secretariat of the IAEA.

21124 (INIS-JP–018, pp. 668-673) **International performance-oriented packaging standards adopted in the united states: Status and impact report.** McCall, D.L. (Westinghouse Hanford Co., Richland, WA (United States)). 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

On January 1, 1991, the U.S. Department of Transportation (DOT) initiated a transition to adopting a modified version of current international standards for packaging and transporting hazardous materials and hazardous wastes. This transition permits a 5-year phase-in period that will impact all phases of hazardous material transportation including material classification and description, packaging for shipment, and hazard communication standards. These changes are being enacted through the DOT Federal Docket HM-181, 'Performance-Oriented Packaging Standards.' These regulatory standards will have dramatic impact on nearly 5 billion tons of hazardous materials transported within the United States each year. This paper summarizes the principal elements of the new DOT regulations, the latest implementation schedule and

impacts on U.S. shipping activities, and discusses outstanding issues that remain to be solved through the next 5 years. (author).

21125 (INIS-JP–018, pp. 1217-1224) **The IAEA regulations for the safe transport of radioactive material; new strategies for the future.** Selling, H.A. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety); Brittinger, M.T.M. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

This paper presents a historic review of 30 years experience with the IAEA's Regulations for the Safe Transport of Radioactive Material as the basis for regulatory control of those materials worldwide. It is demonstrated that the underlying principles and fundamental philosophy have proven their validity and have been the main reason for the excellent safety record of transport operations. The IAEA Regulations are currently halfway a comprehensive revision process aiming at the publication of a new edition by 1996. Although the main principles are likely to be maintained in the next edition of the Regulations, some developments in this area will undoubtedly have an effect on their structure. The main new developments are: the air transport of large quantities of radioactive material, requiring that a risk basis be established which is comparable with other modes of transport, transport of uranium hexafluoride requiring provisions which include the associated chemical hazards, the transport of large volumes of radioactive waste originating from decommissioning of nuclear power stations, and the influence of the new risk estimates for exposure to ionizing radiation and consequently the lower dose limits as recommended by ICRP. This paper will make an attempt to identify the problems associated with those developments, to outline its programme of activities intended to address the problems and to suggest possible solutions as recommended by the IAEA senior advisory group in this subject area. (J.P.N.).

21126 (INIS-JP–018, pp. 1225-1230) **Suggestions for improvement of the IAEA radioactive materials transport regulations.** Hamard, J. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nuleaire). 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The IAEA radioactive material transport regulations (Safety Series 6, 7 and 37) progressively took form between 1960 and 1985 as the result of a series of revisions, of which the most important occurred in 1967, 1972 and 1985. This study covers four main subjects: the applicability of the regulations, and determination of the exception and exclusion levels, allowance for radiotoxicity of the radionuclides in calculation of the allowable quantities A1 and A2 in type A packages, the establishing of a solid basis for surface contamination limits and qualification of the risks by means of labelling and marking packages. The author proposes a number of changes in the regulations concerning these points with a view to making them cleared, and more effective, for the application of safety and radiation protection rules.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

21127 (DPW–58-14-11-Del.) **Summary of heavy water production contract to date.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Nov 1959. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–731). Order Number DE94012620. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides a summary of the Dana heavy water contract as of November 1958.

0702 Radiation Sources

Refer also to citation(s) 21650, 22017, 22282, 22369, 22696

21128 (CONF-940407–21) **ANS cold source neutronics analysis.** Lillie, R.A. Oak Ridge National Lab., TN (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Topical meeting on advances in reactor physics; Knoxville, TN (United States); 11-14 Apr 1994. Order Number DE94012736. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the calculational procedures employed in the ongoing neutronics analysis of the ANS cold source and presents in chronological order some of the more important results from the one- and two-dimensional discrete calculations performed to date in support of the ANS cold source design. In particular, cold neutron currents from cryostat shapes which can be adequately modeled with two-dimensional geometries are compared with and without reentrant cavities. Also, results are presented from one-dimensional comparative liquid hydrogen vs liquid deuterium calculations in which the density, placement, and para-ortho mixture of liquid hydrogen is investigated. In addition, the evolution of the ANS conceptual design cold source from an initial short cylindrical cryostat with hemispherical upper and lower heads employing a natural convection liquid deuterium circulation system to the final spherical design employing a pumped system is described. Finally, performance data and heating rates are presented for some possible alternate ANS cryostat and vacuum jacket materials.

21129 (LA-UR–94-1579) **Nuclear science research at the WNR and LANSCE neutron sources.** Lisowski, P.W. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–15: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012895. Source: OSTI; NTIS; INIS; GPO Dep.

The Weapons Neutron Research (WNR) Facility and the Los Alamos Neutron Scattering Center (LANSCE) use 800 MeV proton beam from the Los Alamos Meson Physics Facility (LAMPF) to generate intense bursts of neutrons. Experiments using time-of-flight (TOF) energy determination can cover an energy range from thermal to about 2 MeV at LANSCE and 0.1 to 800 MeV at WNR. At present, three flight paths at LANSCE and six flight paths at WNR are used in basic and applied nuclear science research. In this paper we present a status report on WNR and LANSCE, discuss plans for the future, and describe three experiments recently completed or underway that use the unique features of these sources.

21130 (ORNL/FTR–4882) **Travel to Denmark for meetings on major synchrotron and neutron beam projects: Foreign trip report, November 29–December 1, 1993.** Appleton, B.R. Oak Ridge National Lab., TN (United States). 14 Jan 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94005440. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended an international expert meeting on synchrotron radiation sources and neutron beam facilities as part of an official US delegation. The US delegation was headed by Iran Thomas of the DOE and included representatives from other DOE national laboratories, the National Science Foundation, and the National Institute of Health. Frank Murray and Katherine Van Sickle from the staff of the Committee of Science, Space, and Technology of the US House of Representatives attended as observers. This international forum was organized and sponsored by the OECD and was hosted by the RISO National Laboratory in Roskilde, Denmark. The purpose of this meeting was to assemble representatives from various countries around the world who are planning

or constructing major synchrotron radiation or neutron beam facilities, and to explore opportunities for participation in these facilities by the countries of the world. The traveler attended to represent the Advanced Neutron Source (ANS) facility which is a steady-state research reactor planned for construction at Oak Ridge National Laboratory beginning in 1995. Because the ANS and similar major facilities are costly and often represent unique capabilities, international cooperation/access is important to consider. The US position paper presented to the conference is attached. Briefly, in the case of the ANS, the preferred mode of access/cooperation appears to be one where the facility would be constructed and operated by the DOE with negotiated access to experimental facilities by other countries.

0703 Isotopic Power Supplies

21131 (LA–12787-PR) **Heat source technology programs: Monthly progress report, December 1993.** George, T.G. (comp.). Los Alamos National Lab., NM (United States). May 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012369. Source: OSTI; NTIS; GPO Dep.

This monthly report describes activities performed in support of Cassini fueled-clad production and studies related to the use of $^{238}PuO_2$ in radioisotope power systems carried out for the Office of Special applications of the US Department of Energy (DOE) by Los Alamos National Laboratory (LANL). Most of the activities described are ongoing; the results and conclusions described may change as the work progresses.

0706 Environmental Aspects

21132 (INIS-JP–018, pp. 307-313) **INTERTRAN 2 - A computer code for calculating the risk from transportation of radioactive materials.** Ericsson, A.M. (AMC Konsult AB, Stockholm (Sweden)); Jaernry, C. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

In this paper a description of IAEA Coordinated Research Program (CRP) dealing with the updating of the computer code INTERTRAN is given. The paper includes a summary of the work performed by several member states within the CRP as well as gives a description of the final product that will be presented to the IAEA. (J.P.N.).

21133 (INIS-JP–018, pp. 314-319) **RADTRAN 5 - A computer code for transportation risk analysis.** Neuhauser, K.S. (Sandia National Labs., Albuquerque, NM (United States)); Kanipe, F.L. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The RADTRAN 5 computer code has been developed to estimate radiological and nonradiological risks of radioactive materials transportation. RADTRAN 5 is written in ANSI standard FORTRAN 77; the code contains significant advances in the methodology first pioneered with the LINK option of RADTRAN 4. A major application of the LINK methodology is route-specific analysis. Another application is comparisons of attributes along the same route segments. Nonradiological risk factors have been incorporated to allow users to estimate nonradiological fatalities and injuries that might occur during the transportation event(s) being analyzed. These fatalities include prompt accidental fatalities from mechanical causes. Values of these risk factors for the United States have been made available in the code as optional defaults. Several new health effects models have been published in the wake of the Hiroshima-Nagasaki dosimetry reassessment, and this has emphasized the need for flexibility in the RADTRAN approach to health-effects calculations. Therefore, the basic set of health-effects conversion equations in RADTRAN have been made user-definable. All parameter values can be changed by the user, but a complete set of default values are available for both the new International Commission on Radiation Protection model (ICRP Publication 60) and the recent model of the U.S. National Research Council's Committee on the Biological Effects of Radiation (BEIR V). The meteorological input data tables have been modified to permit optional entry of maximum downwind distances for each dose isopleth. The expected dose to an individual in each isodose area is also calculated and printed automatically. Examples are given that illustrate the power and flexibility of the RADTRAN 5 computer code. (J.P.N.).

21134 (WSRC-MS–93-580) **Integration of geographic information systems and logistic multiple regression for aquatic macrophyte modeling.** Narumalani, S. (Nebraska Univ., Lincoln, NE (United States). Dept. of Geography); Jensen, J.R.; Althausen, J.D.; Burkhalter, S.; Mackey, H.E. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9404153–1: 1994 annual meeting of Americal Society Photogrammetry and Remote Sensing, Reno, NV (United States), 24-28 Apr 1994). Order Number DE94012379. Source: OSTI; NTIS; GPO Dep.

Since aquatic macrophytes have an important influence on the physical and chemical processes of an ecosystem while simultaneously affecting human activity, it is imperative that they be inventoried and managed wisely. However, mapping wetlands can be a major challenge because they are found in diverse geographic areas ranging from small tributary streams, to shrub or scrub and marsh communities, to open water lacustrian environments. In addition, the type and spatial distribution of wetlands can change dramatically from season to season, especially when nonpersistent species are present. This research, focuses on developing a model for predicting the future growth and distribution of aquatic macrophytes. This model will use a geographic information system (GIS) to analyze some of the biophysical variables that affect aquatic macrophyte growth and distribution. The data will provide scientists information on the future spatial growth and distribution of aquatic macrophytes. This study focuses on the Savannah River Site Par Pond (1,000 ha) and L Lake (400 ha) these are two cooling ponds that have received thermal effluent from nuclear reactor operations. Par Pond was constructed in 1958, and natural invasion of wetland has occurred over its 35-year history, with much of the shoreline having developed extensive beds of persistent and non-persistent aquatic macrophytes.

08 HYDROGEN

21135 (LBST–11/92) **Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. 282p. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

In the course of Phase II of the Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP), it was found that a number of topical aspects required more detail investigations, specific tests etc. than could be cared for within Phase II, under the constraint of available time and funds. Consequently, supplementary tasks have been defined and contracted. This report is the Final Report on the results achieved during the performance of these tasks. The tasks cover a wide field for example LH_2 Airbus studies some can be associated with more than one aspect. The table following hereunder may give an overview over the tasks covered. For all 23 papers a separate subject analysis has been carried out. (orig.)

0801 Production

Refer also to citation(s) 20630, 21220, 21835, 22486

21136 (CONF-931269–, pp. 49-52) **Fundametnal study on production of hydrogen with photovoltaic module.: Derivation of annual hydrogen production amount from simulation.** Sakai, M. (Science University of Tokyo, Tokyo (Japan)); Sekiguchi, N.; Tani, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 268p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to manufacture hydrogen by utilizing solar energy, a characteristics test has been given on a hydrogen generator using photovoltaic modules and solid polymer electrolyte electrolyzing system to derive the annual hydrogen generation amount. The equipment uses polycrystalline silicon photovoltaic modules consisting of five series cells connected in 12 parallel rows and solid polymer electrolytic membranes. Experimental data were used to analyze I-V characteristics of the photovoltaic modules, and power efficiency of electrolytic cells in the hydrogen generator to derive a relational formula for the hydrogen manufacturing amount. It was revealed that the hydrogen generation from the hydrogen generator connected directly with the photovoltaic modules is about 14,800 liters from the measurement data on annual cumulative insolation of 1149 kWh/m^2. With a system to supply power from the solar cells into the hydrogen generator while retaining the hydrogen electrolyzing voltage by using a DC-DC converter, the hydrogen generation can go up to about 18,900 liters, whereas this system has been concluded more effective. 2 refs., 10 figs., 4 tabs.

21137 (DOE/MC/10637–3703, pp. Paper 15, 46) **Catalytic coal gasification for hydrogen production pilot plant data and scaleup considerations.** Hauserman, W.B. (Univ. of North Dakota, Grand Forks, ND (United States)). North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. In *Low-rank coal research semiannual report, January 1992–June 1992.* 858p. Order Number DE94008889. Source: OSTI; NTIS.

This is the final semiannual report for a six-year program conducted by the Energy and Environmental Research Center (EERC) exploring the effects of catalytically enhanced reactivity of coals to accelerate gasification rates for the production of hydrogen and hydrogen-methane mixtures. As a companion volume (1), released concurrently with this report, a brief Executive Summary report will cover the entire project chronologically and summarize the salient conclusions. This semiannual is essentially a topical report, presenting detailed analysis of pilot-scale studies conducted over the past year, which has been cited in the preceding semiannual report (2).

21138 (LBST–11/92, pp. 300.1-300.11) **Fuel cell bus operation, system investigation H_2 bus.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

The WP covers two tasks: - Prepartion of Technical Catalogue: In cooperation with ICIL, AR have compiled a technical catalogue, providing the impartial descriptions, both of existing technology and regulations, and the likely future developments of these, as to remedy the first problem faced by a potential hydrogen bus fleet operator viz the absence of an impartial description of the available vehicle and fuels systems together with the absence of a description of regulatory and safety factors which need consideration. - Fuel Cell Bus Operation - System Investigation H_2 Bus: The application of fuel cell electric generation systems to hybrid electrical buses or electrical busses without any storage system on board is considered. The task will cover safety and environmental aspects, a cost estimate and a market evaluation. (orig.)

21139 (LBST–11/92, pp. 430.1-430.26) **Norwegian hydro-energy in Germany (NHEG) - a case study.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

The case study NHEG considers a system where Norwegian hydro energy is exported to Germany as hydrogen or electricity. The aim is to evaluate the technical and economical feasibility of a demonstration project paving the way for larger commercial projects in the future. (orig.)

0802 Storage, Transport, and Handling

Refer also to citation(s) 21138, 21145, 21833, 21903

21140 (LBST–11/92, pp. 360.1-360.11) **Pressure and temperature evolution in H_2 barges.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The investigation covers the transport of loaded barges (filling rate 85%) from Canada to Hamburg and of near empty barges (5%) back to Quebec, and the period during which the barges will serve as storage tanks onshore. 'The first part' of the final report presents the results of the analysis of the ship motion of the liquid hydrogen barge carrier designed in EQHHPP, phase II. Roll angle and acceleration parameters are calculated. The second part of the final report presents the results of the finite element analysis of the liquid hydrogen tank designed in EQHHPP, phase II. Maximum stand alone periods are calculated for different configurations and failure modes'. (orig.)

21141 (LBST–11/92, pp. 380.1-380.3) **Supplementary work for MCH path.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The report covers - Site Evaluation, - Meteorological Data - Material F low, - Description of Plant, - Electrical System, - Safety and Environmental Assessment, - Approvals, - Cost Estimates. (orig.)

21142 (LBST–11/92, pp. 440.1-440.10) **Control valves for the operation of liquid-hydrogen vessels.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The scope of work calls for the design, construction and test of a controlvalve for the operation of liquid-hydrogen vessels. In the Final Report, 'the development of controlvalves for the operation of LH_2-powered vehicles, especially with a flow rate of approx. 50 l/min and the solutions are described. We determined the properties of an improved prototype down to cryogenic temperatures measuring the tightness before and after a wear test with LN_2. A conception of a insulated valve unit, the operation instruction for the remote control of the complete process between storage vessel and LH_2 powered engine are fixed'. (orig.)

21143 (LBST–11/92, pp. 450.1-450.7) **VSI cryo containers for LH_2 transport.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The work under this contract shall comprise the basic design, evaluation, and cost estimate of cryogenic containers for LH_2 transportation using the MBB Vacuum Super Insulation-technology. (orig.)

21144 (LBST–11/92, pp. 480.10-480.17) **Task B: Expert system for the valuation of LH_2 storage systems concerning tightness and leak-before-break behaviour.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The Final Report describes the intentions of the system, the codes relevant to the EQHHPP, and available data bases. It summarizes: In the following, a summary is given of the results of basic considerations, comparative compilations and other investigations carried out in context with the realization of a first concept of an expert system for analyses of the tightness and leak-before-break behaviour of liquid hydrogen storage systems. (orig.)

0804 Economic, Industrial, and Business Aspects

Refer also to citation(s) 21137, 21138, 21832, 21833, 21834

21145 (LBST–11/92, pp. 410.1-410.6) **Filling of H_2 barges and road tankers.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

The goal of our study is the minimization of gaseous H_2 losses during the transfer between the barges and the road tankers in the Hamburg area. We studied two alternative solutions: - Either a complete boil-off reliquefier (helium cycle), - or a partial liquefier using hydrogen recycling. (orig.)

21146 (LBST–11/92, pp. 420.1-420.24) **LH_2 evaporation.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

This WP contains three objectives: - LH_2-Evaporation, - Concept Comparison 'Liquid Hydrogen'/'Slush Hydrogen'/'Subcooled Hydrogen', - LH_2-Filling and Decanting Concept. (orig.)

0808 Properties and Composition

Refer also to citation(s) 21903

0809 Environmental Aspects

Refer also to citation(s) 21833

0830 Combustion

Refer also to citation(s) 21137, 21887

09 BIOMASS FUELS

Refer also to citation(s) 21894

0907 Resources

21147 (JY/MT-TIED–9) **Impedance spectroscopy and temperature acclimation of forest trees.** Repo, T. Joensuu Univ. (Finland). Faculty of Forestry. 1993. 53p. Order Number DE94771057. Source: OSTI; NTIS.

The main aims of this study were twofold: An electrical impedance spectroscopy was developed for studying the cell structure of trees, and the temperature acclimation of Scots pine (Pin us sylvestris L.) and Norway spruce (Picea abies (L.) Karst.) was studied and modelled. By exposing shoots of trees to a series of frost temperatures the cellular response after thawing, as assessed by impedance technique (1 kHz), followed a logistic sigmoid curve. Nonlinear curve fitting allowed estimation of the standard error of frost hardiness. An impedance method could be used to assess the frost hardiness of trees with the exception of their most frost hardy state. By measuring real and imaginary levels of impedance over wide range of frequencies (20 Hz to 1 MHz), and by using complex nonlinear least squares curve fitting, equivalent electrical circuits (lumped and distributed) were constructed for the bark and the wood of Scots pine shoots. The impedance spectra of bark and wood differed considerably from one another, and the spectra of shoots changed with the stage of development in the spring. All the spectra were characterized by strongly depressed centers which is indication of wide distribution in cell structure. Frost hardiness of Scots pine and Norway spruce varied in the field conditions, between -3.5 deg C and below -40 deg C. The phase of the most rapid acclimation started in about mid September and in mid April. The temperature range from 0 to 10 deg C was the most important for commencement of acclimation. Frost hardiness attained its lowest value when the growth rate was about maximum.

0908 Production

Refer also to citation(s) 22649, 22671, 22672

21148 (DOE/ER/20077–2) **Membrane function in lipid mutants of Arabidopsis: Second year progress report, [June 15, 1992–June 14, 1994].** Browse, J.A. Washington State Univ., Pullman, WA (United States). Mar 1994. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92ER20077. Order Number DE94012836. Source: OSTI; NTIS; GPO Dep.

The fad2 mutants are deficient in activity of the endoplasmic reticulum oleate desaturase that is the main enzyme responsible for polyunsaturated lipid synthesis in developing seeds of oil crops. A comparison of wild type and fad2 seeds developing on heterozygous (Fad2/-) plants was used as a model for genetically engineered high oleate oilseeds of species such as soybean and canola. When fad2 seeds developed at normal temperatures (22°C), they showed high viability comparable to wild type seeds. When a portion of seed development took place at 6°C, germination of the wild type siblings remained high but germination of fad2 segregants declined considerably. This was true even when exposure to low temperature was limited to the final stages of seed filing and maturation. Compared to wild type, fully viable fad2 seeds produced at 22°C had reduced lipid contents and were slower to germinate at 10°C and 6°C. These results indicate that for some oilseed species at least, molecular genetic manipulation of oleate levels in the oil may result in plant lines with unacceptable performance in the field.

21149 (DOE/ER/20086–1) **The plant mitochondrial mat-r gene/nad1 gene complex: Progress report.** Wolstenholme, D.R. Utah Univ., Salt Lake City, UT (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER20086. Order Number DE94013695. Source: OSTI; NTIS; GPO Dep.

The authors have completed sequencing the segments (totalling 19 kb, both complementary strands) of the maize mtDNA molecule that encode the entire NADH dehydrogenase subunit (nadl) gene. They have identified nucleotides in mature transcripts of the nadl

gene that are edited and have generated clones of cDNAs of entire mature (fully spliced) nadl transcripts. They have examined the relative rates of splicing in transcripts of the four nadl gene group II introns and begun examining nadl intron cDNAs to determine the extent and distribution of RNA edits in introns, in order to evaluate the possibility that intron excision and exon splicing might be editing independent.

21150 (NEI-DK–1520) **Cost-reducing methods for the handling of straw for district heating and cogeneration plants.** Nielsen, J. (Statens Jordbrugsoekonomiske Institut (Denmark)); Parsby, M.; Keller, P. Statens Jordbrugstekniske Forsoeg, Horsens (Denmark). Mar 1994. 45p. (In Danish). Contract ENS-1383/90-0005. Order Number DE94771114. Source: OSTI; NTIS.

EFP-90.

The amount of work needed (and cost) in relation to different methods (using various forms of equipment) of harvesting/gathering straw to be used as fuel for district heating and cogeneration plants is calculated with the help of the DRIFT computer programme, and costs/work needed for the delivery of this fuel to district heating plants is reckoned on the basis of working-data compiled during a number of years. Results are presented in the form of tables and show that the Agropack system is the cheapest in use and that manipulation of large bales of straw result in the lowest costs in relation to pressing and slicing. It is recommended that sliced straw is stored in covered barns with solid floors. The automatic slicer is the most costly in use. The container slicing system seems to be the cheapest in use and is also the most efficient and flexible. Transport of the straw to the plants for use is more expensive in the case of sliced straw. It is concluded that the best method of reducing costs is to make the Hesston bale system more efficient and to regard the whole process from field to combustion in the plant as one overall system. If a larger moisture content was allowed in the straw to be combusted the cost of storage, and perhaps also of pressing, would be lower. It is important to investigate at what price the farmers would be willing to sell their straw and how long it should be allowed to lay in the fields. Farmers are eager to remove it from the fields as quickly as possible, preferably during in the course of 1-2 weeks. But the most efficient utilization of the harvesting/gathering equipment involves waiting until there is a sufficient volume of straw to gather. (AB)

0909 Processing

Refer also to citation(s) 20636, 21149

21151 (CONF-940526–2) **Use of cellulase from pseudomonas fluorescens for the hydrolysis of wastepaper in an attrition bioreactor.** Scott, T.C.; Cosgrove, J.M.; Coon, C.L.; Kenney, J.A.; Scott, C.D. Oak Ridge National Lab., TN (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 16. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN (United States); 9-13 May 1994. Order Number DE94013623. Source: OSTI; NTIS; GPO Dep.

Typically, municipal solid waste is made up of about 48% paper, 25% glass, 13% plastics, 6% steel 2% aluminum and 6% other materials. The volume of this material is very large, estimated to be in excess of 180 million tons/yr in the United States with newsprint alone making up about 14% of the total. Segregated wastepaper products could be an ideal feed material for biological conversion to sugars with the possibility of subsequent conversion to ethanol. If half of the newsprint were recycled and only half of the remaining paper products were available as a feedstock, over 30 million tons/yr would be available for processing. With an 80% conversion of the included cellulose to ethanol, this would represent a potential for over 4 billion gal/yr of ethanol or nearly 4 times the present yearly U.S. production. The primary processing steps for such a process must include: (1) handling and size reduction of wastepaper, (2) enzyme production for use in a hydrolysis reactor, (3) enzymatic hydrolysis of the cellulose fraction, (4) a fermentation system for conversion of hydrolyzed sugars to a crude aqueous ethanol, and (5) a means of concentrating and purifying the end product. At the present time, the critical steps in this approach involve the production and use of enzymes in an effective hydrolysis reactor. One possible approach involves the simultaneous saccharification of cellulose and fermentation of the resulting glucose to ethanol (SSF). The approach studied in this note represents an alternative to SSF. The idea is to optimize the enzymatic hydrolysis and fermentation steps separately. For wastepaper hydrolysis, the authors approach is to provide an attritting force which constantly creates fresh surface area for enzyme attack. Specifically, this paper describes preliminary findings for the use of a bacterial cellulase in an attrition bioreactor for the purpose of enhancing the hydrolysis of cellulose in wastepaper.

21152 (DOE/CE/40772–8) **The production of chemicals from food processing wastes using a novel fermenter separator: Annual progress report, January 1993–March 1994.** Dale, M.C.; Venkatesh, K.V.; Choi, H.; Salicetti-Piazza, L.; Borgos-Rubio, N.; Okos, M.R.; Wankat, P.C. Purdue Univ., Lafayette, IN (United States). 15 Mar 1994. 214p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85CE40772. Order Number DE94012839. Source: OSTI; NTIS; GPO Dep.

The basic objective of this project is to convert waste streams from the food processing industry to usable fuels and chemicals using novel bioreactors. These bioreactors should allow economical utilization of waste (whey, waste sugars, waste starch, bottling wastes, candy wastes, molasses, and cellulosic wastes) by the production of ethanol, acetone/butanol, organic acids (acetic, lactic, and gluconic), yeast diacetyl flavor, and antifungal compounds. Continuous processes incorporating various processing improvements such as simultaneous product separation and immobilized cells are being developed to allow commercial scale utilization of waste stream. The production of ethanol by a continuous reactor-separator is the process closest to commercialization with a 7,500 liter pilot plant presently sited at an Iowa site to convert whey lactose to ethanol. Accomplishments during 1993 include installation and start-up of a 7,500 liter ICRS for ethanol production at an industry site in Iowa; Donation and installation of a 200 liter yeast pilot Plant to the project from Kenyon Enterprises; Modeling and testing of a low energy system for recovery of ethanol from vapor is using a solvent absorption/extractive distillation system; Simultaneous saccharification/fermentation of raw corn grits and starch in a stirred reactor/separator; Testing of the ability of 'koji' process to ferment raw corn grits in a 'no-cook' process.

21153 (DOE/ER/13368–10) **Enzymology of acetone-butanol-isopropanol formation: Progress report, June 16, 1990–June 15, 1993.** Chen, Jiann-Shin. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Jun 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER13368. Order Number DE94013037. Source: OSTI; NTIS; GPO Dep.

During the current project period, alcohol dehydrogenases (ADH) and acetoacetyl-CoA-reacting enzymes of C. beijerinckii were purified to homogeneity. Structural and catalytic properties of the purged enzymes were determined. A range of conditions was used to investigate the activity and stability of each enzyme. This information will facilitate the selection of differential assays and handling conditions for the unequivocal determination of the activity of a specific enzyme in crude extracts. In genetic studies, crude extracts are often the most practical material for the monitoring of specific enzyme activities. A selective assay is especially important when the relative levels of interfering enzymes change during physiological or genetic manipulations. The results from our study of ADH and aldehyde dehydrogenase (ALDH) demonstrate the technical difficulties associated with the measurement of these enzyme activities in crude extracts. First of all, because the two enzymes catalyze sequential reactions, the NAD(P)H-linked activities of ADH and ALDH in crude extracts are easily over or underestimated or masked. Secondly, the presence of multiple ADHs with overlapping coenzyme specificities in the same cell makes it difficult to assign the measured activity to a specific isozyme. Lastly, these enzymes are especially oxygen-sensitive in crude extracts, which, necessitates the use of good anaerobic techniques. We have determined the N-terminal amino acid sequence (the first 30-45 residues) the primary/secondary ADH the ALDH, the 3-hydroxybutyryl-CoA dehydrogenase, and both subunits of the CoA-transferase. The amino acid sequences will allow us to design

oligonucleotide probes for the cloning of their structural genes and then to study the organization and regulation of these genes. Using this approach, we have cloned and sequenced the ADH gene encoding the primary/secondary ADH.

21154 (DOE/ER/13370–T3) **[Conversion of acetic acid to methane by thermophiles]: Annual progress report.** Zinder, S.H. Cornell Univ., Ithaca, NY (United States). Feb 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13370. Order Number DE94012478. Source: OSTI; NTIS; GPO Dep.

Acetate is the precursor of approximately two-thirds of the methane produced by anaerobic bioreactors and many other methanogenic habitats. Besides their intrinsic interest, thermophilic acetotrophic methanogenic cultures usually grow at least twice as fast as their mesophilic counterparts, making them more amenable to study. In recent years, attention has been mainly focused on the thermophilic acetate utilizing methanogen Methanothrix strain CALS-1. Methanothrix, also called Methanosaeta, is one of only two methanogenic genera known to convert acetate to methane, the other being Methanosarcina. The faster-growing more versatile Methanosarcina has been better studied. However, when one examines anaerobic digestor contents, Methanothrix is often the dominant acetate-utilizing methanogen. As described in previous progress reports, the authors have achieved methanogenesis from acetate in cell-free extracts of Methanothrix strain CALS-1 grown in a pH auxostat. Using these cell extracts, specific activities for methanogenesis from acetate and ATP of 100–300 nmol/min were routinely obtained, levels comparable to the rate in whole cells, which is not usually the case in methanogenic extracts. Recently obtained results are given and discussed for the following: Methanogenesis in crude extracts; Role of the cell membrane in methanogenesis from acetate; Carbon monoxide dehydrogenase; Novel thermophilic cultures converting acetate to methane; and Methanol-utilizing methanogen.

21155 (DOE/ER/20065–1) **Oxidative enzymes involved in fungal cellulose degradation: Progress report, [May 15, 1992–May 14, 1994].** Renganathan, V. Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92ER20065. Order Number DE94012843. Source: OSTI; NTIS; GPO Dep.

This report describes progress in understanding of the structure, function, and mechanism, and the role of cellobiose dehydrogenase (CDH) of Phanerochaete chrysosporium in lignocellulose degradation.

21156 (DTH-LET-RE–94-2) **Systematization of thermal conversion.** Brandt, P.; Henriksen, U. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. Mar 1994. 103p. (In Danish). Order Number DE94771145. Source: OSTI; NTIS.

The physical system wherein the gasification of biomass takes place is dealt with. The processes are illustrated by block diagrams, a list of characteristics for the description of the gasifier, (including ash formation, pressure drop, stability etc.) and a schematic explanation where these characteristics are related to the gasification processes. The designs of seven types of gasifiers are described and comparative evaluations are made. Examples of schemes/tables for registering temperature gradients and energy transport, pressure gradients etc. are presented. (AB)

0920 Combustion

Refer also to citation(s) 21292

0930 Economic, Industrial, and Business Aspects

21157 (INIS-mf–14225) **Wood waste production for industrial use.** Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Institut fuer Oekonomie. Arbeitsbericht, v. 91/3. Niendieker, V.; Wippermann, H.J. Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg (Germany). Inst. fuer Oekonomie. Jan 1991. 21p. (In German). Order Number DE94774214. Source: OSTI; NTIS (US Sales Only); INIS.

Wood wastes are a product of regular selective thinning. Selective thinning is done along silvicultural lines, mostly with a view to obtaining a large proportion of high-grade wood products. In so far the widely deplored discrepancy between expenditure for forest care and profits from the sale of the accruing types of wood does not necessarily mean that wood waste production is ineconomical. In fact, wood waste production is economical as long as the cost of handling wood wastes is balanced by profits. (orig.)

0940 Transport, Handling, and Storage

21158 (SEI-EED–28) **Wood fuel transportation and distribution in Zambia.** Hibajene, S.H. (Dept. of Energy, Ministry of Energy and Water Development, Lusaka (Zambia)). Stockholm Environment Inst. (Sweden). 1994. 10p. Order Number DE94771027. Source: OSTI; NTIS.

Published in cooperation with SIDA.

This paper discusses Zambian charcoal markets using data from interviews undertaken in three cities. These data show that there are large numbers of agents engaged actively in the production, transport and distribution stages of the industry. As a result, competitive behaviour seems to prevail even though it is an informal industry. Although efficiency gains might be achieved through road improvement, the establishment of rural supply depots, and increased seasonal arbitrage, the market appears to serve urban consumers well. Government intervention is required only to improve roads and monitor future shifts in the operation of the industry. 3 figs, 5 tabs

0980 Waste Management

Refer also to citation(s) 20662, 21149

21159 (ANL/ES/CP–80939) **Evaluation of a Fourier transform infrared continuous emission monitor field test at a TSCA incinerator.** Mao, Z. (Argonne National Lab., IL (United States). Energy Systems Div.); Demirgian, J.C.; Reedy, G. Argonne National Lab., IL (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940528–3: Incineration conference: 13th international symposium on thermal treatment technologies, Houston, TX (United States), 9-13 May 1994). Order Number DE94013301. Source: OSTI; NTIS; GPO Dep.

A Fourier transform infrared (FTIR) spectrometer was field tested as a continuous emission monitor (CEM) at the Toxic Substances Control Act (TSCA) incinerator at K-25 in Oak Ridge, Tenn., from August 23 to September 3, 1993. This paper reports results obtained from this field test. The FTIR spectrometer and the long-path cell used for the field test were specially designed and constructed, so that optical alignment of the system can be easily performed in the field. The system was tested in the laboratory and then in the field for instrument stability and signal-to-noise ratio. Time interval required for taking a new background spectrum was determined. It appears that the system performs well both in the laboratory and in the field. The field test followed a standard operation procedure (SOP), developed for the test, based on a proposed EPA protocol for applying FTIR in emission testing. Sixteen compounds were selected as target analytes. Ethylene was used as a calibration transfer standard to ensure that spectral performance of the FTIR spectrometer in the field is consistent with that in the laboratory. Spike tests were regularly conducted with a known concentration of a mixture of six compounds and also with SF_6 to check the accuracy of the monitoring system. Data sampling, processing, and reporting were automated to collect data every 10 min, and data were collected throughout the test as long as liquid nitrogen was available in the detector. The instrumentation and software performed flawlessly. Although the field test was a success, further improvement is necessary. Suggestions for revising the SOP and the proposed EPA protocol are discussed.

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 20621, 20622, 22060

21160 (CONF-9309257--Vol.2, pp. 707-737) **Isobutanol dehydration: A key step in producing MTBE from Syngas.** Armstrong, P.A.; Bhatt, B.; Heydorn, E.C.; Toseland, B.A. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-91PC90018. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

A process for the dehydration of isobutanol to isobutylene has been demonstrated in DOE's LaPorte, Texas, AFDU (Slurry Phase Alternative Fuels Development Unit). Preliminary results from the August plant trial are described. The laboratory development of the process including details of the kinetics of the dehydration are reported.

21161 (CONF-9309257--Vol.2, pp. 739-763) **High octane ethers from synthesis gas-derived alcohols.** Klier, K. (Lehigh Univ., Bethlehem, PA (United States)); Herman, R.G.; Feeley, O.C.; Johansson, M.A.; Menszak, J. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-90PC90044. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The principal objective of this research project is to synthesize fuel grade ethers, primarily high cetane methyl isobutyl ether (MIBE) and high octane methyl tertiary butyl ether (MTBE), as well as higher tertiary ethers, from $H_2/CO/CO_2$ coal-derived synthesis gas via alcohol mixtures that are rich in methanol and isobutanol. Organic resins, including the Amberlyst-15, -35, -36, and -1010 resins and duPont Nafion-H fluorocarbon resin, have been tested in a continuous downflow stainless steel reactor for the synthesis of MIBE and MTBE from methanol and isobutanol, principally in the temperature range of 90-120°C and pressures of ambient to 1.5 MPa (220 psig). Nafion-H was an active catalyst that selectively produced MIBE and dimethylether (DME) at high pressure and isobutene at low pressures ($\leq$0.1 MPa). The strongly acidic Amberlyst catalysts were more active catalysts but with lower selectivities, which could be partially controlled by reaction parameters. A wide range of strongly acid inorganic catalysts have also been tested for ether synthesis and dehydration of isobutanol. Higher reaction temperatures were found to be necessary. Since the reaction pathways and products are kinetically controlled, kinetic and mechanistic studies are being carried out to provide for optimization of the ether and olefin synthesis from methanol and isobutanol. Reaction of $CH_3{}^{18}OH$ with ^{16}O-containing isobutanol over the solid acid Nafion-H resin gave the two distinctly labelled C_5 ethers ^{16}O-MIBE and ^{18}O-MTBE. This indicates that MTBE is not derived from MIBE, the kinetically favored product, and that MTBE is formed via a different pathway that might involve intermediate isobutene.

21162 (CONF-9309257--Vol.2, pp. 765-787) **Progress on developing technology for producing higher alcohols from synthesis gas.** Roberts, G.W. (North Carolina State Univ., Raleigh, NC (United States)); Shertukde, P.V.; McCutchen, M.S.; Peeler, C.M.; Lamb, H.H. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

A substantial number of catalysts for the direct conversion of synthesis gas to higher alcohols have been prepared, characterized and tested for activity and selectivity. All of these catalysts were of the general composition $Rh/MO_x/Al_2O_3$, where M denotes a metal that acts as a promoter for the Rh. The promoters studied to date are Nb, Mo, W and Re. The selectivity to total oxygenates, including methanol and formaldeyde, increased in the order: no promoter $\cong$ Nb $\cong$ W < Mo < Re. The best total oxygenate selectivity, about 76% based on moles of carbon monoxide converted, was obtained with a catalyst comprised of 1 wt.% Rh/6 wt.% Re/Al_2O_3. Unfortunately, this catalyst had a very low activity, about 0.67 moles CO/kg. (catalyst), hr. at the standard testing conditions of 200°C, 3.4 MPa., 9000 $hr.^{-1}$ space velocity and 2/1 H_2/CO ratio.

21163 (CONF-9309257--Vol.2, pp. 789-813) **Coal liquefaction and gas conversion contractors review conference.** Brown, D.M. (Air Products and Chemicals, Inc., Allentown, PA (United States)). USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

Air Products and Chemicals, Inc. (APCI) has progressed into the third year of a four-year Alternative Fuels program with the DOE. In the past two years, a number of new process technologies that convert coal-derived syngas to liquid fuels have been demonstrated at DOE's Alternative Fuels Development Unit (AFDU), located at LaPorte, Texas. The demonstrations required a scale-up of different technologies derived from bench-scale investigations of slurry-phase to a 22.5' (ID) diameter slurry bubble column. A single-step slurry-phase processes for coproduction of dimethylether (DME) and methanol, important fuels and chemical building-blocks, was demonstrated at the AFDU in 1991. Combining three reversible reactions - methanol synthesis, methanol dehydration and water-gas shift reactions in a single reactor drives each reaction thermodynamically by removing its inhibiting products as reactants in the subsequent reaction. Substantial increase in per-pass syngas conversion (by at least 30% at commercial space velocities) was demonstrated by mixing a small amount of dehydration catalyst with a methanol catalyst.

21164 (CONF-9309257--Vol.2, pp. 815-838) **Catalysts and process development for synthesis gas conversion to isobutylene.** Anthony, R.G. (Texas A&M Univ., College Station, TX (United States)); Akgerman, A.; Postula, W.S.; Feng, Z.; Philip, C.V.; Erkey, C. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-90PC90045. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

Trickle bed reactor experiments using precipitated and commercial zirconia resulted in the production of more C_2-C_3 hydrocarbons than the fixed bed gas phase reactor when using a hydrogen to CO ratio of 1. Because of problems associated with solvent cracking the reactor temperature for the trickle bed was limited to 400°C, whereas temperatures up to 450°C had been used for the fixed bed reactors. Co-feeding H_2S with the synthesis gas resulted in reduction of C_1 to C_{13} production rates, an increase in C_5 production and an increase in the production of 3-methyl-1-butene. Zirconia prepared with Ce resulted in a highly active and selective catalyst with isobutylene production rates of 4 to 8.5 kg/(m^3 cat. h) for CO conversions of 15 to 34%. Kinetic models necessary for reactor design are first order for CO and one half order for hydrogen, indicating the dissociation of hydrogen on the catalyst surface. Carbon dioxide was found to be the most abundant species on the surface of the catalyst and retards the rate of reaction. A modification of the Anderson Schultz Flory distribution resulted in an empirical procedure for estimating product distributions.

21165 (CONF-9309257--Vol.2, pp. 839-854) **Technology development for cobalt Fischer-Tropsch (FT) catalyst.** Singleton, A.H. (Energy International Corporation, Pittsburgh, PA (United States)). USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

One of the most promising ways for producing liquid hydrocarbons from coal is via coal gasification to synthesis gas, followed by Fischer-Tropsch (FT) synthesis to convert the syngas to a mixed

product consisting primarily of straight chain hydrocarbons. Syngas from coal tends to have a low H_2/CO ratio and some additional hydrogen must be generated by the water gas shift (WGS) reaction. Traditionally, iron catalysts have been used for FT synthesis when the syngas is coal-derived, because iron catalysts have the ability to simultaneously carry out the WGS reaction. Recently, there has been renewed interest in the use of Co as a commercial FT catalyst. Co has a higher specific activity than Fe; it produces primarily straight chain paraffins; and has shown good lifetimes. The considerable commercial interest is evidenced by the large number of patents relating to catalysts and processes which have been issued to, among others, Gulf, Shell, Exxon, and Statoil. Although much activity has taken place in the development of Co catalysts in recent years, much of this work has been privately sponsored and thus is maintained as proprietary. Thus, the time is right for assembling all the current information and developing a family of potentially commercializable catalysts. There are two main broad objectives of this three-year project: (1) to identify and demonstrate a procedure that will reproducibly produce supported FT cobalt catalysts which meets suitable activity, selectivity, and lifetime criteria and is suitable for use in a slurry bubble column reactor; and (2) to provide design and cost estimates for a facility that can provide cobalt catalyst for testing in a slurry bubble column PDU facility. The activity and selectivity criteria are outlined.

21166 (CONF-9309257–Vol.2, pp. 855-876) **Fischer-Tropsch Co/Ru Catalyst Development.** Frame, R.R. (UOP, Des Plaine, IL (United States)); Gala, H.B. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The objective of this contract is determining whether a benefit can be obtained from incorporating a small amount of ruthenium (Ru) into a supported cobalt (Co) catalyst for slurry autoclave processing and whether a low methane-producing catalyst can result. Recent work on this contract has centered on the development of high-activity Co-based Fischer-Tropsch catalysts supported on a steamed and acid-washed Y zeolite. The preparation, characterization, and performance evaluation of these catalysts is reviewed. These catalysts are prepared by the impregnation of CO and other metals onto a steamed and acid-washed Y zeolite followed by calcination and reduction. Manganese, zirconium and sometimes Ru are used in addition to Co. The support, method of impregnation, and use of zirconium and manganese in addition to Co are integral parts of the supported catalyst developed under a previous DOE contract to a division of Union Carbide that is now part of UOP. The support was chosen because the steaming procedure creates many pores in the 50 to 100 Å diameter range, a size considered ideal for supporting Co crystallites for Fischer-Tropsch reaction.

21167 (CONF-9309257–Vol.2, pp. 877-909) **Technology development for iron Fischer-Tropsch catalysts.** Tungate, F.L. (United Catalysts, Inc., Louisville, KY (United States)); Xu, Liguang; Spicer, R.L.; Houpt, D.J.; O'Brien, R.; Lin, R.; Milburn, D.R.; Chokkaram, S.; Chary, K.; Davis, B.H. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-91PC90056. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The objectives for the catalyst development are, on the one hand, the attainment of the highest possible activity and life, and on the other hand, the highest possible selectivity to the desired products. In this study, the catalyst is to be designed to operate in a slurry phase reactor. Furthermore, the catalyst is to be based on iron and is to be prepared in a continuous process. The continuous preparation is to be designed so that catalysts with a common formulation that are prepared at different times will have the same catalytic properties. The research program was designed to remove much of the uncertainty regarding the following aspects of catalyst synthesis and testing: (1) the role of promoters and additives; (2) the optimum method of preparation; (3) the reproducibility of large batches of iron catalysts; and (4) the pretreatment of the catalysts. The research to produce data to address the above four issues is outlined and the progress toward attaining these goals is described.

21168 (CONF-9309257–Vol.2, pp. 911-942) **Fischer-Tropsch iron catalyst development.** Frame, R.R. (UOP, Des Plaines, IL (United States)); Gala, H.B. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-90PC90055. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The main objective of this contract is the development of the means of preparing 100 lb/day batches of a precipitated iron-based Fischer-Tropsch catalyst for slurry processing. The actual catalyst results from reduction of an iron oxide-based precursor in the slurry reactor. The final catalyst should be high in activity yet produce less than 5 mol-% of methane and ethane. An important part of the preparation of precipitated iron-based Fischer-Tropsch catalysts is the addition of potassium. Potassium is usually the metal of choice to enhance catalyst activity and control product selectivity. For the catalyst production method being developed for the present contract, potassium is added by a separate impregnation-calcination step using potassium carbonate prior to catalyst activation. This step is a separate one that if eliminated, would reduce the cost of preparing the catalyst.

21169 (CONF-9309257–Vol.2, pp. 943-970) **Pretreatment effect and process evaluation studies of precipitated iron Fischer-Tropsch catalysts.** Bukur, D.B. (Texas A&M Univ., College Station, TX (United States)); Lang, X.; Koranne, M.; Nowicki, L. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-89PC89868. Grant 999903-222. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The objective of this contract is to develop catalysts with enhanced slurry phase activity and higher selectivity to fuel range products, through a better understanding and systematic studies of the effects of pretreatment procedures, promoters and binders (silica) on catalyst performance. The two main research tasks for this contract are Pretreatment Effect Research and Development of Improved Iron/Silica Catalysts. A brief description of progress in each of these areas is given below.

21170 (CONF-9309257–Vol.2, pp. 971-984) **Moessbauer spectroscopy study of iron-based catalysts used in Fischer-Tropsch synthesis.** Rao, K.R.P. (Univ. of Kentucky, Lexington, KY (United States)); Huggins, F.E.; Mahajan, V.; Huffman, G.P.; Davis, B.; O'Brien, R.J.; Xu, Liguang; Bukur, D.B. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC22-90PC90039. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

Moessbauer spectroscopy is perhaps the best technique available for quantitative determination of iron phase distributions in complex multiphase samples. It is therefore very well suited to the identification of different phases present in iron catalysts at various stages of genesis in the Fischer-Tropsch (FT) synthesis process. In the present studies, we have carried out Moessbauer characterization of the iron phases present in reduced and used catalysts. A quantitative determination of the phase distribution and its changes with time on steam has enabled us to correlate the iron phases with the FT and WGS activity.

21171 (CONF-9309257–Vol.2, pp. 985-1014) **The selective catalytic cracking of Fischer-Tropsch liquids to high value transportation fuels.** Reagan, W.J. (Amoco Oil Co., Naperville, IL (United States)). USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States);

27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The objective of this program is to prepare high-value transportation fuels, including gasoline, distillate, and gasoline range ethers and alcohols from the selective catalytic cracking of Fischer-Tropsch wax. The test results from both small scale (1-5 grams catalyst) and pilot plant (2500 grams catalyst) units show that the wax (Sasol) feedstock readily converts (>85%) to C_4 - gas (high in propylene and C_4 olefins) and naphtha products. The major products of interest, isobutylene, isoamylenes, and C_5-430°F naphtha vary with the level of conversion of the wax feedstock and the type of zeolite (Y, HZSM-5, Beta) catalyst. Further zeolite modification studies show only minor variations in wax conversion and product selectivity among the zeolite types. The reactive isoolefins in the light naphtha product fractions from the pilot plant runs readily form methyl ethers by reaction with methanol. The ether yields are dependent on equilibrium constraints and carbon chain length of the olefin. Economic analysis of the product distributions from the eight pilot plant runs show that the net product values ($/d) for a complex refinery (contains ether unit) are always higher than for a simple refinery (no ether unit).

21172 (CONF-9309257–Vol.2, pp. 1015-1053) **'The Standing of Fischer-Tropsch Diesel in an assay of fuel performance and emissions'.** Erwin, J.; Ryan, T.W. III. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. Contract NREL SUB YZ-2-113215-1. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

Two Fischer-Tropsch feedstocks, one from hydrocracking of Arge wax, the other a straight-run product from modern DOE slurry reactor technology, were distilled into a diesel range cut (350°-650°F) for comparison with other diesel stocks. Three petroleum diesel fuel components, representative of different feed sources and processing histories as well as the F-T diesel samples were distilled into narrow cutpoint fractions of similar boiling point petroleum samples included straight-run diesel, light coker gas oil, and light cycle oil. Each stock was cut into 6 to 8 fractions. The overall goal was to select stocks and to create fractions for analysis to determine the composition and properties that control combustion characteristics of each sample. Laboratory tests included hydrocarbon type, density, elemental composition, aromatic composition, and other properties. Combustion characteristics included ignition performance in a constant volume combustion apparatus (CVCA) and exhaust gas composition. The CVCA ignition delay time measurements were calibrated to provide predictions of the cetane number. The results are discussed in terms of the effects of the measured properties on the ignition quality with emphasis on the distribution of cetane number across the distillation range of the various components.

21173 (CONF-9309257–Vol.2, pp. 1055-1070) **Baseline design/economics for advanced Fischer-Tropsch technology.** Choi, G.N.; Tam, S.S.; Fox, J.M. III; Kramer, S.J.; Marano, J.J. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

The Baseline design has shown that indirect coal liquefaction is competitive with conventional crude oil production and refining at a crude cost of 30.7 $/bbl. This is considered an excellent result at this stage of development and its quite competitive with direct liquefaction. Design conditions for the Fischer-Tropsch reactor are considered conservative and it is expected that the sensitivity studies will indicate that a significant improvement is possible. The Baseline study represents only one of several possible processing options for Advanced Fischer-Tropsch Technology. While an intensive optimization study was carried out in designing the F-T slurry reactor loop, the same attention was not given to other developing gasification and upgrading options could positively impact the F-T technology economics. We recommend the Baseline study be extended to include a detailed investigation of the following: (1) Texaco coal gasification technology; (2) FCC for F-T wax upgrading; (3) Economic analysis of producing raw instead of refined F-T products.

21174 (CONF-9309257–Vol.2, pp. 1071-1080) **Opportunities for reducing product costs in indirect liquefaction.** Gray, D. (MITRE Corp., McLean, VA (United States)); Tomlinson, G.; El-Sawy, A. USDOE Pittsburgh Energy Technology Center, PA (United States). [1993]. DOE Contract AC04-76DP00789. From Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993. In *Coal liquefaction and gas conversion: Proceedings: Volume 2.* 473p. Order Number DE94008962. Source: OSTI; NTIS.

Integrated computerized simulation models of indirect coal liquefaction have been studied for the past several years. The objective of these models is to quantify potential reductions in product costs that could result from improvements in the technology brought about by continuing research and development. The models have shown that there are significant reductions in the cost of diesel and gasoline from advanced indirect liquefaction plants compared to the SASOL configuration. SASOL uses fixed-bed Lurgi coal gasifiers and Synthol circulating bed Fischer-Tropsch (FT) reactors. This configuration produces excellent gasoline and diesel fuel, however, because of the large production of methane from both gasifier and FT synthesis, the overall efficiency of the process to an all-liquid product is low and hence the relative cost of production is high. The advanced configuration, although at present only conceptual and not commercial as is SASOL, would use Shell entrained coal gasification and slurry-phase FT synthesis. This combination produces very little methane, and allows the Shell synthesis gas to be directly utilized in the FT process. Operating the FT synthesis at high alpha to produce wax, further allows the selective production of diesel fuel. The simulation model of this advanced indirect liquefaction process has estimated that cost reductions of about 27 percent compared to the SASOL configuration could be possible provided that the results obtained at bench and pilot plant scale can be duplicated at commercial size, and that certain operational problems can be adequately solved. Preliminary results from the Bechtel/Amoco indirect baseline configuration show that the capital cost estimate for the advanced conceptual plant is almost identical to the MITRE estimate, and thus the resulting cost of gasoline and diesel fuel from this plant should be similar, depending on the economic parameters used.

21175 (DOE/PC/91034–T8) **The economical production of alcohol fuels from coal-derived synthsis gas: Quarterly technical progress report number 10, 1 January 1994–31 March 1994.** West Virginia Univ. Research Corp., Morgantown, WV (United States). Apr 1994. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91034. Order Number DE94013059. Source: OSTI; NTIS; GPO Dep.

The WVU plug-flow microreactor system is now complete. Screening runs with this system will commence. Computer control is being installed in the second WVU unit. Additional hardware has been suggested for this system so that it can be used either to screen additional catalysts or to obtain kinetic data on selected catalyst samples. Synthetic preparations and characterizations of molybdenum-based sulfide and nitride catalysts are ongoing. Modelling studies are continuing satisfactorily. A more detailed model of the reaction kinetics, to account for individual alcohols rather than a lumped highter-alcohol, has been inserted into the model of a plug-flow reactor. A solution methodology to maximize the profitability of alcohol production, separation and blending has been developed. The temperatures, pressures, flowrates, and key component recoveries in the separation steps are the optimization variables. The probability of this process becoming economically feasible in the near future appears to be extremely small given the low return on capital investment associated with the production of alcohol from coal. If coal derived alcohols are to become alternative transportation fuels, then the capital cost associated with the process must be reduced, specifically the cost of the gasifiers, or significant changes need to be made in the composition of the mixed alcohol

product. A methodology for performing Monte Carlo studies to determine quantitatively the uncertainties relevant to future decisions to build an alcohol-fuels plant is still being developed.

21176 (DOE/PC/91301–10) **Ethanol synthesis and water gas shift over bifunctional sulfide catalysts: Technical progress report, December 1993–February 1994.** Klier, K.; Herman, R.G.; Deemer, M. Lehigh Univ., Bethlehem, PA (United States). Zettlemoyer Center for Surface Studies. Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91301. Order Number DE94012611. Source: OSTI; NTIS; GPO Dep.

During this quarter, a 10 wt % CsOOCH/MoS_2 catalyst was prepared for catalytic testing using slight modifications of previous attempted preparations. The MoS_2 was prepared from MoS_3 via thermal decomposition. The resultant product was then doped using an aqueous solution of cesium formate under vacuum. The doped catalyst was then loaded into a single pass fixed-bed tubular flow reactor under nitrogen to minimize exposure to air. The catalyst was pretreated with 2 vol % H_2/98 vol % N_2 at 400C and then tested at 8.3 MPa at 245, 256, 265, 175, and 295C for a total of 168 hours. The catalyst displayed the activity and selectivity similar to that of previous workers. The surface areas of the doped and undoped catalysts were also determined.

21177 (DOE/PC/92529–T6) **Transient studies of low temperature catalysts for methane conversion: Quarterly technical progress report, January 1, 1994–March 31, 1994.** Wolf, E.E. Notre Dame Univ., IN (United States). Dept. of Chemical Engineering. 30 Apr 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92529. Order Number DE94013478. Source: OSTI; NTIS; GPO Dep.

In our previous report we summarized activity – selectivity results obtained on three metallo oxide catalysts LaCoO3, LaNiO3 and LaRhO3. It was found that although these materials were highly active for methane conversion, their selectivity varied from total combustion for the LaCoO3, to partial combustion for the LaRhO3 to C2 hydrocarbon formation for the Li promoted LaNiO3. In light of the above results, we focused on studying the Li promoted LaNiO3 catalyst using the transient techniques previously developed in our group. The effect of methane and oxygen pulses, isotopic exchange of oxygen and isotopic methane switches is reported. These experiments revealed that Li prevented the total oxidation of the hydrocarbon products being formed from methane. The role of Li is to block the rate of oxygen exchange between the gas phase and the lattice, thus inhibiting the oxidation of the C2 hydrocarbons.

21178 (DOE/PC/92532–T7) **Fischer-Tropsch synthesis in supercritical reaction media: Progress report, January 1, 1994–March 31, 1994.** Subramaniam, B.; Bochniak, D.; Snavely, K. Kansas Univ., Lawrence, KS (United States). Dept. of Chemical and Petroleum Engineering. Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92532. Order Number DE94012601. Source: OSTI; NTIS; GPO Dep.

Efforts were focused on testing and preparing the reactor. Testing was done for pressure and temperature control. Heating elements will have to be added to the Al blocks surrounding the reactor. Analytical method development (GC) is also reported; retention indices compare favorably with White et al.

1003 Properties and Composition

21179 (DOE/PC/92104–T5) **Advanced thermally stable jet fuels: Technical progress report, July 1993–September 1993.** Schobert, H.H.; Eser, S.; Song, C.; Hatcher, P.G.; Walsh, P.M.; Coleman, M.M. Pennsylvania State Univ., University Park, PA (United States). Coll. of Earth and Mineral Sciences. Dec 1993. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92104. Order Number DE94013070. Source: OSTI; NTIS; GPO Dep.

The Penn State program in advanced thermally stable coal-based jet fuels has five broad objectives: (1) development of mechanisms of degradation and solids formation; (2) quantitative measurement of growth of sub-micrometer and micrometer-sized particles suspended in fuels during thermal stressing; (3) characterization of carbonaceous deposits by various instrumental and microscopic methods; (4) elucidation of the role of additives in retarding the formation of carbonaceous solids; (5) assessment of the potential of production of high yields of cycloalkanes by direct liquefaction of coal. An exploratory study was conducted to investigate the pyrolysis of n-butylbenzene in a flow reactor at atmospheric pressure. A number of similarities to trends previously observed in high-pressure static reactions were identified. The product distribution from pyrolysis of n-tetradecane at 400°C and 425°C was investigated. The critical temperatures of a suite of petroleum- and coal-derived jet fuels were measured by a rapidly heating sealed tube method. Work has continued on refining the measurements of deposit growth for stressing mixtures of coal-derived JP-8C with tetradecane. Current work has given emphasis to the initial stages of fuel decomposition and the onset of deposition. Pretreatment of JPTS fuel with PX-21 activated carbon (50 mg of PX-21 in 15 mL JPTS) delayed degradation and prevented carbon deposition during thermal stressing at 425°C for 5 h in nitrogen and air atmospheres. Clear indications of initial and subsequent deposit formation on different metal surfaces have been identified for thermal stressing of dodecane. Seven additives were tested for their ability to retard decomposition of dodecane at 450°C under nitrogen. Nuclear magnetic resonance data for Damrnar resin indicates that structures proposed in the literature are not entirely correct.

13 HYDRO ENERGY

1306 Environmental Aspects

Refer also to citation(s) 22641, 22642, 22669

21180 (DOE/BP/00631–3) **Hood River and Pelton Ladder evaluation studies: Annual report 1993.** Olsen, E.A.; French, R.; Newton, J.A. Confederated Tribes of the Warm Springs Reservation of Oregon, OR (United States); Oregon Dept. of Fish and Wildlife, Portland, OR (United States). Apr 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-89BP00631. Order Number DE94013090. Source: OSTI; NTIS; GPO Dep.

The primary goals of the Hood River Production Project (HRPP) are (1) to increase production of wild summer and winter steelhead (Oncorhynchus mykiss) and (2) to reintroduce spring chinook salmon (Oncorhynchus tshawytscha) into the Hood River subbasin. Harvest and escapement goals are identified in the Hood River and Pelton Ladder master plans. Strategies for achieving the production goals were initially devised based on various assumptions about carrying capacity, survival rates, and escapement of stocks of anadromous salmonids in the Hood River subbasin. To obtain the information needed to more accurately estimate each parameter we operated an adult trap at Powerdale Dam to collect life history and escapement information on stocks of anadromous salmonids entering the Hood River subbasin. The Oregon Department of Fish and Wildlife (ODFW) funded the monitoring program at Powerdale Dam beginning in December 1991, and Bonneville Power Administration (BPA) took over the funding in August 1992. The contract period for this project was 1 October 1992 through 30 September 1993. Objectives for FY 93 were (1) to develop a long term monitoring and evaluation plan for the Hood River and Pelton Ladder (Hood River/Pelton Ladder) projects, (2) to identify monitoring and evaluation needs for FY 94, (3) to prepare an annual report summarizing data collected at Powerdale Dam through 30 September 1993, and (4) to continue work on the various activities needed to construct hatchery facilities in the Hood River subbasin and for making the necessary modifications to Pelton Ladder. This report summarizes the life history and escapement data collected at the Powerdale Dam adult trap and the status of the engineering work.

21181 (DOE/BP–2321) **Columbia River basin fish and wildlife program annual implementation work plan for fiscal year 1994.** USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. Feb 1994. 225p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013096. Source: OSTI; NTIS; GPO Dep.

This document is part of Bonneville Power Administration's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The Fiscal Year 1994 (FY 1994) Annual Implementation Work Plan (AIWP) presents Bonneville Power Administration's (BPA's) plan for implementation of the Columbia River Basin Fish and Wildlife Program (Program). The purpose of the Program is to guide BPA and other federal agencies in carrying out their responsibilities to protect, mitigate, and enhance fish and wildlife in the Columbia River Basin. Phase I began the work of salmon recovery with certain fast-track measures completed in August 1991. Phase II dealt with Snake and Columbia river flow and salmon harvest and was completed in December 1991. Phase III dealt with system-wide habitat and salmon production issues and was completed in September 1992. Phase IV planning, focusing on resident fish and wildlife, began in August 1993, and was finished and adopted in November 1993. This report provides summaries of the ongoing and new projects for FY 1994 within the areas of juvenile migration, adult migration, salmon harvest, production and habitat, coordinated implementation, monitoring and evaluation, resident fish, and wildlife.

21182 (DOE/BP/02836–1) **Salmon Saprolegniasis.** Mueller, G.J. (ed.). Washington Univ., Seattle, WA (United States). Dept. of Botany. Apr 1994. 269p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC79-91BP02836. (CONF-9208258–: Saprolegnia in salmon symposium, Portland, OR (United States), 8 Aug 1992). Order Number DE94013237. Source: OSTI; NTIS; GPO Dep.

The chapters in this compilation were presented orally at the symposium Saprolegnia in Salmon, on August 8, 1992, at the annual meeting of the Mycological Society of America. This is the first international conference on salmon saprolegniasis in this century. The symposium was composed of four parts. The first characterized the problem of saprolegniasis from historical, taxonomic, and salmonid physiology perspectives. Pathogenicity and control measures were the subject of the second and third parts respectively. While all authors presented new findings or ideas pertinent to their geographical region, the fourth part of the conference emphasized current regional research.

21183 (DOE/BP/93497–5) **Kootenai River fisheries investigation: Stock status of burbot and rainbow trout and fisheries inventory: Annual report 1993.** Paragamian, V.L. Idaho Dept. of Fish and Game, Boise, ID (United States). Apr 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-88BP93497. Order Number DE94013087. Source: OSTI; NTIS; GPO Dep.

Seventeen burbot Lota lota were caught in the Kootenai River with two sizes of hoop nets baited with fish. One burbot was a recapture. Burbot catch from March 19 through May 10, 1993 averaged 0.03 fish/net/day. Total length ranged from 367 to 701 mm and weight from 369 to 2,610 g (mean = 916 g). Nearly all burbot were caught at Ambush Rock. Preliminary findings are that burbot abundance in the Kootenai River is substantially less than it was in the late 1970s. Rainbow trout Oncorhynchus mykiss and seven other species of fish were sampled in tributary streams of the Kootenai River. A single pass was made with a backpack electroshocker. Species diversity ranged from two found in Cascade Creek to eight each in Snow and Caribou creeks. Most streams were partially channelized in their lower reaches, and these segments were lower in species richness. Sculpins Cottus sp. were often the only species found in channelized segments. Trout were caught in all streams. Rainbow trout were the most abundant salmonid. Cutthroat trout 0. clarki numbers were highest in Cascade Creek. I estimated a total of 5,268 anglers fished 13,698 h (± 3,913), for 129 h/km (n± 36), from March through August 1993. Fisherman averaged 2.6 h/trip based on completed trip information. The estimated total angler catch was 5,937 fish (± 3,395), of which 3,676 (± 3,246) were kept. Angler effort for 1993 was similar to that of 1982. Angler harvest of rainbow trout was estimated at 700 fish (± 873) and they averaged 276 mm total length. Mean catch rate for anglers fishing for rainbow trout was about 0.02 fish/h. Rainbow trout comprised 17% of the catch. Angler harvest of cutthroat trout was 105 fish (± 118) at less than 0.01 fish/h and averaged 356 mm total length.

21184 (DOE/SWPA–94012500) **Southwestern Power Administration site environmental report for calendar year 1993.** USDOE Southwestern Power Administration, Tulsa, OK (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012500. Source: OSTI; NTIS; INIS; GPO Dep.

During CY 93, Southwestern was not involved in any programs that had a direct effect on the environment, involving endangered species, protection of wetlands, or increased electromagnetic radiation. Southwestern continued to function throughout the year in an operations and maintenance posture with minor substation projects. Southwestern received an environmental management audit by the Department of Energy's Office of Environmental Audit (EH-24), during CY 1992. The purpose of the audit was to give Southwestern, DOE headquarters, and the Secretary an indication of the status of Southwestern management's effectiveness in discharging its duties in an environmentally responsible manner. The audit identified 17 findings. An action plan was developed and remediation of the findings has been accomplished. Several strengths were identified during the audit with regard to the environmental programs at Southwestern. Most importantly, senior management at Southwestern has taken actions to increase environmental awareness throughout the organization which is evidenced by the creation of the Environmental, Safety, Health, and Security Office.

1307 Power-Conversion Systems

21185 (DOE/ER/12113–2) **Further development of the pneumatic method to harness hydropower and its experimental implementation in the State of Maine: Final report, [February 15, 1990–February 14, 1993].** Gorlov, A.M. Northeastern Univ., Boston, MA (United States). Dept. of Mechanical Engineering. Mar 1994. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER12113. Order Number DE94012349. Source: OSTI; NTIS; GPO Dep.

This report contains conclusive results of the research project entitled "Further Development of the Pneumatic Method to Harness Hydropower and its Experimental Implementation in the State of Maine" sponsored by the US Department of Energy (Contract DE-FG02-91ER12113). The results obtained by this research are considerably beyond the original goals anticipated by the contract which were a theoretical study of the method only and its possible applications. In fact, the success of the analytical research program has allowed us to move on to development, construction and testing of a physical model of the hydro-air power converter and, subsequently, to development of a well equipped hydro-pneumatic power laboratory at Northeastern University. Photographs Ia and 2a show both the laboratory and the model. Good performance of the model proves that the hydro-pneumatic concept holds much promise for development of an ecologically safe and commercially attractive novel approach to harnessing ultra low-head hydropower. As a result, private companies have started to support this new technology, and to invest money in its further development and construction of demonstration power plants (Appendix 1). Visitors at the Northeastern University laboratory often praise this new technique, as is attested by the articles in the Wall Street Journal (Appendix 2) and the Technology Review (Appendix 3).

14 SOLAR ENERGY

1401 Resources and Availability

21186 (CONF-931269–, pp. 193-196) **Research on passive solar energy application in Bolivia. Part 1.: Meteorological characteristics of Bolivia.** Ishihara, O. (Kumamoto University, Kumamoto (Japan)); Kaihara, K.; Saito, I. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993*

JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993). Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to utilize solar energy in Bolivia, South America, discussions have been given on meteorological characteristics and other data. The meteorological features of Bolivia are classified into those for plateaus, hilly areas, and low plains. Air temperature rises in the increasing order of the plateaus, hilly areas, and low plains. Altitudes apparently influence the temperature rising trend, keeping the air temperature reduction rate constant at about 0.45 to 0.50°C/100 m throughout a year. Relative humidity varies largely in the plateaus between the rainy and dry seasons; the low plains are high in temperature and humidity throughout a year; and the hilly areas have a temperature of about 20°C and a humidity of about 40% throughout a year. Duration of insolation is long in winter on the plateaus and the hilly areas, and shortest in winter and longest in summer on the low plains. However, the insolation is stable at 4 to 6 kwh/day throughout a year, with no noticeable difference among the three areas. A 3-km climate map was prepared on air temperatures, insolation time and amount based on the meteorological data for 43 cities in Bolivia. 3 refs., 6 figs.

21187 (CONF-931269–, pp. 197-200) **Construction of solar energy map by cloud images received from GMS.** Otani, K. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Horigome, T.; Saito, T.; Kurokawa, K.; Tsuda, I. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Discussions have been given on a method to estimate full insolation data necessary for designing and operating the photovoltaic power generation, by using cloud images received from a geostationary meteorological satellite (GMS). Because life of clouds is shorter than conditional change on the ground surface and life of snow on the ground, a minimum value of albedo observed during a certain period of time has been taken as the albedo on the ground surface. An insolation reflection model in the earth-atmosphere system may be conceived for estimating the insolation, and a non-linear formula has been introduced as an insolation estimating formula. Partial regression coefficient has been derived by utilizing GMS images received from August 1, 1991 through July 31, 1992 and the full insolation observation data available at meteorological offices, and classifying the data into three categories according to the number of snowing days in nine selected locations, and the conditions on the ground. As a result of estimating full insolation on different parts in Japan by using a non-linearity model that keeps model parameters constant, the number of months with estimation error of 10% or less has reached more than 80% of the total number of months. A full insolation distribution map for the entire South Asia has been prepared based on the above results. 8 refs., 2 figs., 5 tabs.

21188 (CONF-931269–, pp. 201-204) **Characteristics of solar radiation for use of solar energy in basis of insolations measured.** Baba, H. (Kitami Institute of Technology, Hokkaido (Japan)); Kanayama, K.; Endo, N.; Saito, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports the insolation data taken at the Kitami area for 15 years since 1978 for the purpose of utilizing solar energy more effectively. The insolations have been measured by a horizontal pyranometer and a normal direct actinometer installed on the roof of an experiment building, recorded as hourly integral values. In average monthly insolation measurements, the average global insolation in January for 15 years has been 6.6 MJ/m^2d, with a variance of about 15%. That for July has been 17.0 MJ/m^2d, with a variance of about 25%. Variation in the direct insolation has reached more than double that in the global insolation. Average insolation in sunny days has been larger by 20% to 25% in the global insolation and as much as 28% to 55% in the direct insolation than the monthly average insolation. As a result of discussing the number of sunny days that solar energy can be utilized, it was found that the number of sunny days on which the solar energy can be utilized amounts to 60% to 80% of the total number of days, with February, March, and October having more number of such days than those during June through August which had relatively fewer number of such days. 6 refs., 11 figs.

21189 (CONF-931269–, pp. 205-208) **Simple measurement of integrated solar energy with azo-dye impregnated films.** Ishikawa, T. (Chiba University, Chiba (Japan). Remote Sensing and Image Research Center); Yoshimura, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

An experiment has been carried out on measuring the insolation on human bodies and change in insolation on the ground due to buildings by using a simplified global radiation actinometer that uses acetate films impregnated in azo-dyes. A scarecrow was used to measure insolation on a human body, which was sewn with 1-cm wide films on different parts and oriented toward south for full exposure to the sunlight. Fading of the color on the films was compared with that of a film affixed on a horizontal face. As a result, it was found that the maximum insolation amounts were about 1.3 to 1.4, the largest having been on the brim of a hat, the left shoulder and the left chest. To measure insolation on locations shaded by a building, a building model was placed facing toward south, with films spaced 5 cm apart behind the model. Insolations at the winter solstice and the summer solstice were measured by inclining the ground surface. As a result, the insolations on the ground surface where influence from the building would be little were 1.12 to 1.15 at the winter solstice and 1.52 to 1.62 at the summer solstice, the difference having been thought to have been caused from difference in the sun's altitude. 10 refs., 3 figs., 1 tab.

1403 Economic, Industrial, and Business Aspects

21190 (INIS-mf–14227) **The construction of a process line for high efficiency silicon solar cells under clean-room conditions: Final report.** Aberle, A.; Faller, C.; Grille, T.; Glunz, S.; Kamereweard, F.J.; Kopp, J.; Knobloch, J.; Klussmann, S.; Lauby, E.; Noel, A.; Paul, O.; Schaeffer, E.; Schubert, U.; Seitz, S.; Sterk, S.; Voss, B.; Warta, W.; Wettling, W. Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany). Aug 1992. 150p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 0328931A. Order Number DE94774226. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this research project was to plan, construct and test a clean-room technology laboratory for the manufacturing of silicon solar cells with 20% efficiency (1.5AM). In addition to the establishment of the laboratory, there existed the case of establishing the material and technological fundamentals of high-efficiency solar cells, testing and optimizing all stages of production as well as constructing test stands for accompanying characterisation work. The following final report describes the construction of the laboratory and characterisation systems, the material elements of

high-efficiency solar cells as well as the most important results of solar cell production and optimisation. (orig./BWI)

21191 (INIS-mf–14243) **Production of an optimized matrix hologram and development of a copying process for large format holograms for solar applications: Final report.** Stojanoff, C.G.; Brasseur, O.; Froehlich, K.; Kubitzek, R.; Schuette, H.; Tropartz, S. Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie. 15 Jul 1992. 118p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 0328591B. Order Number DE94774268. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the research project is the development of a technique for reasonably priced mass- production of large area holographic focussers for photo-electrics. The holograms up to 1 m^2 in size simultaneously act as spectrum dispersing and focussing optical elements, which focus the sunlight in discrete bands on spectrally matched solar cells. The three most important characteristics of the holographic focussers are the refractive efficiency, the spectrum bandwidth and the central working wavelength. The optimum values of the parameters conditional on the variation of the layer thickness and the mean refractive index via the aperture of the hologram and on the ability of the layer to make large modulations of the refractive index possible. The mass-production of large format holographic lenses demands precise coating of the carrier substrate of the hologram copies with dichromate gelatine and is done with the aid of a scanning copying process. (orig.)

1405 Solar Energy Conversion

Refer also to citation(s) 21205, 21231, 21255, 21891, 22644, 22646, 22648

21192 (CONF-931269–, pp. 65-68) **Plan to achieve the practical use of P.V. systems which is fit for 'the age of change'.** Anno, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper describes a proposal on a medium to long period plan intended of achieving practical use of photovoltaic power generation systems in Japan. This plan calls for starting with 3-kW system x 1,000 houses in the third year of the plan, which will exceed 70,000 houses using photovoltaic power generation facilities in the eighth year. Beside this target, use of practical photovoltaic power generation facilities will start in the fourth year from 200 locations to exceed 8,000 locations in the eighth year. Separately from these programs, the plan proposes a base system that will install 3-kW system x 100 houses every year starting in the first year spending a total national budget of about 8 billion yen for ten years to support general citizens technically. It is desired that the plan will give a consideration that the upper limit of a burden for individuals to pay for photovoltaic power generation systems would be 150,000 yen to 250,000 yen. It is also expected that commercially available systems would not be uniform standard models, but as diverse as compatible with living styles of individuals and regional characteristics. 9 refs., 2 tabs.

21193 (CONF-931269–, pp. 69-72) **Measurements and analysis of influence factors and efficiency of PV system. Part 2.: Analysis of results from annual measurements.** Ishihara, O. (Kumamoto University, Kumamoto (Japan)); Hiyama, T.; Kozuma, S.; Fujihiro, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Measurements and analyses have been made on the relationship between power generation efficiency and external factors in relation to amorphous silicon photovoltaic cells and polycrystalline silicon photovoltaic cells. The measurements have been performed on the case where photovoltaic cell modules were installed on a perpendicular face and a slanted face on southward fixed racks, and the case where the modules were installed on a perpendicular face and a slanted face on turn tables of automatic solar azimuth following system. The power generation efficiency according to the installation faces was found highest in the perpendicular and slanted faces of the following system for the polycrystalline silicon cells, highest in the perpendicular face of the following system and lowest in the slanted face of the following system for the amorphous silicon cells. With respect to annual change in the generation efficiency, the polycrystalline silicon cells had as large variation as ranging from 7% to 10%, while the amorphous silicon cells had a small variation of about 4%. The maximum output of the photovoltaic cells is in a near proportion with insolation, but lower in the afternoon than in the morning in spite of the same insolation throughout a day. This trend was stronger in the polycrystalline silicon cells than in the amorphous silicon cells. 2 refs., 6 figs., 4 tabs.

21194 (CONF-931269–, pp. 73-76) **Characteristics of PV cell temperature on stand-off type PV array.** Nishikawa, S. (Kandenko Co. Ltd., Tokyo (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Measurements and analyses have been made on simulated houses to identify output variations in photovoltaic cells installed on roofs due to temperature rise. Measurements of the photovoltaic cell temperatures were made on stand-off type photovoltaic arrays installed on roofs made of Japanese roof tiles, roofing slates, and metal plates. A time band windless with long and strong insolation in summer was selected to identify the highest values. As a result, it was found that the slate roof had the largest temperature rise, and the Japanese tile roof the smallest. As a result of analyzing the data, it was inferred that temperatures of the PV cells in an atmospheric temperature of 40°C and an insolation strength of 1 kW/m^2 were from 72°C to 81°C, and the output voltage would drop down to 155 V to 162 V against the standard 200V. With regard to air cooling effect, a breeze with an average velocity of even as gentle as 1 to 2 m/s can reduce the temperature by 10°C or more as compared to windlessness. Very little difference was found in cooling effect between the kinds of roofing materials. 1 ref., 3 figs., 9 tabs.

21195 (CONF-931269–, pp. 93-96) **Development of intermittent flow redox battery. Part 3.** Tsuda, I. (Electrochemical Laboratory, Tsukuba (Japan)); Kurokawa, K.; Nozaki, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Assuming the use of redox batteries in photovoltaic power generation systems, attempts have been made on improving the system efficiency by using intermittent operation in pumps, and raising resistance in piping systems. An experiment has been given on three modes of pump continuous operation, shutdown and intermittent

operation, by using an experimental equipment that suppresses leakage of current through the electrolyte. The experiment investigated current dependence of the system efficiency. The efficiency according to pump operation time per operation in the intermittent operation was found highest in the case of 60-second operation. Reduction in the efficiency is relatively small even in an operation of longer than 120 seconds, showing the effect of resistance increase in the piping system. In continuous operation, it was learned that the current efficiency increases with increasing current density, and the power efficiency has a maximum value. The current efficiency in intermittent operation was found higher than in the continuous operation, verifying the effect of the intermittent pump operation. It was found that increase in pressure loss in the electrolyte can be suppressed and the resistance in the piping system can be increased by using bubbles in an inert gas. 3 refs., 8 figs., 3 tabs.

21196 (CONF-931269–, pp. 157-160) **Thermal design and simulation for hybrid photovoltaic-thermal solar energy conversion system.** Kamoshida, J. (Shibaura Institute of Technology, Tokyo (Japan)); Hu, K.; Sato, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Analytical studies have been given on a photovoltaic-thermal hybrid collector panel with an intention to utilize solar energy more effectively. The photovoltaic-thermal hybrid solar energy conversion system utilizes electric power generated by solar cells installed on house roofs and prevents efficiency drop due to temperature rise in the solar cells by air-cooling rear face of the solar cells, as well as recovers and utilizes heat energy. This system uses a compression/absorption heat pump cycle that uses two kinds of non-azeotropic point mixtures. The pump has been found to have better performance coefficients than in the conventional compression heat pumps. According to an experiment on installation angles of the hybrid collector, it was found that change in the inclination angle in laminar flow forced convective flows does not give much effect to heat transfer characteristics. It was learned that the photovoltaic-thermal hybrid collector increases its heat collecting efficiency with increasing air blowing amount, resulting in larger effect of preventing temperature rise in the solar cells and in a capability of maintaining high electric power conversion efficiency. 3 refs., 10 figs.

21197 (CONF-931269–, pp. 161-164) **Studies of a hybrid heat pump system using panels with photovoltaic modules as the evaporator.** Nishikawa, M. (Chubu Electric Power Co. Inc., Nagoya (Japan)); Sone, T.; Ito, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Experimental discussions have been given on a hybrid heat pump system that utilizes heat generated by solar cells installed on a heat collector face by recovering the heat with use of refrigerant of a heat pump. The experimental device is so structured that it can select and use a vaporizer without fins, a finned vaporizer, or both. Each unit has an automatic temperature expansion valve at its inlet to maintain the degree of super heat at 8°C to 12°C according to the temperature at the unit outlet. It was found as a result of a heat pump characteristics test that, in order to increase the panel area for the purpose of increasing the power generation and vaporization at higher temperatures, it is preferable to use also a finned panel so that the vaporizing area be self-adjusted when insolation is excessive. It was also verified that, while the module conversion efficiency is 7.9% when the hybrid panel element temperature is 65°C under operation without a load, the conversion rate when it is used as a vaporizer was 9.2% at 30°C, an improvement of about 14%. 1 ref., 8 figs., 1 tab.

21198 (CONF-931269–, pp. 217-220) **Optimum design of composite panel with photovoltaic-thermo module. 2.** Sasamoto, Y. (Science University of Tokyo, Tokyo (Japan)); Inoue, K.; Tani, T.; Hirata, Y.; Kadotani, K.; Takahashi, Y. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Experimental studies have been carried out on a composite panel with photovoltaic-thermo modules combining solar cells with thermo-elements that utilize Pelier effect, with an objective of developing a radiation air conditioning system using solar energy. An experiment has been performed on a thermo-element panel capable of radiation air conditioning by varying the polarity of DC power supplied to solar cell operated thermo-elements. In the experiment, the difference between air temperatures and panel temperatures in performing room cooling were derived for the case where the panel inclination angle is varied, and electric power that is determined by the insolation intensities according to the angle inclination x the panel area x the solar cell efficiency is supplied. As a result, it was found that the panel cooling face temperature does not depend on the inclination angle. In an experiment on a hot-face temperature control panel, a constant temperature tank was set to an optional hot-face temperature using the tank as a heat sink, and the relation among the air temperatures, the hot-face temperatures, and the panel cold-face temperatures were derived by supplying electric power determined by the insolation intensities x panel area x solar cell efficiency. As a result, it was found that the cold-face temperatures on walls and ceilings can be reduced lower by about 3°C than the room temperature when the heat sink temperature was set to the same value as the ambient temperature under an insolation intensity of 900 W/m^2 and a solar cell efficiency of 10.9%. 3 refs., 9 figs., 8 tabs.

21199 (NREL/TP–451-6469) **Investigation of polycrystalline thin-film $CuInSe_2$ solar cells based on ZnSe windows: Annual subcontract report, 15 Febraury 1992–14 February 1993.** Olsen, L.C. (Washington State Univ. at Tri-Cities, Richland, WA (United States)). National Renewable Energy Lab., Golden, CO (United States). May 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006936. Source: OSTI; NTIS; GPO Dep.

Investigations of ZnSe/CIS solar cells are being carried out in an effort to improve the efficiencies CIS cells and to determine if ZnSe is a viable alternative to CdS as a window material. MOCVD growth of ZnSe is accomplished in a SPIRE 500XT reactor housed in the Electronic Materials Laboratory at WSU Tri-Cities by reacting a zinc adduct with H_2Se. Conductive n-type ZnSe is grown by using iodine as a dopant. Ethyliodide was mixed with helium and installed on one of the gas lines to the system. ZnSe films have been grown on CIS substrates at 200°C to 250°C. ZnO is also being deposited by MOCVD by reacting tetrahydrofuran (THF) with a zinc adduct. ZnSe/CIS heterojunctions have been studied by growing n-ZnSe films onto 2 cm x 2 cm CIS substrates diced from materials supplied by Siemens and then depositing an array of aluminum circular areas 2.8.mm in diameter on top of the ZnSe to serve as contacts. Al films are deposited with a thickness of 80 to l00 Åso that light can pass through the film, thus allowing the illuminated characteristics of the ZnSe/CIS junction to be tested. Accounting for the 20 to 25 % transmittance through the Al film into the ZnSe/CIS structure, current devices have estimated, active-area AM1.5 efficiencies of 14 %. Open circuit voltages > 500 mV are often attained.

21200 (SAND–93-1684C) **Progress on the Emitter Wrap-Through silicon solar cell.** Gee, J.M.; Buck, M.E.; Schubert, W.K.; Basore, P.A. Sandia National Labs., Albuquerque, NM

(United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940423–1: 12. European photovoltaic solar energy conference and exhibition, Amsterdam (Netherlands), 11-15 Apr 1994). Order Number DE94010382. Source: OSTI; NTIS; GPO Dep.

The Emitter Wrap-Through (EWT) solar cell is a back-contacted solar cell with a carrier-collection junction ("emitter") on the front surface. Elimination of grids from the front surface allows for higher performance by eliminating grid-obscuration losses and reducing series resistance, while keeping an emitter on the front surface maintains high collection efficiency in solar-grade materials with modest diffusion lengths. The EWT cell uses laser-drilled vias to wrap the emitter diffusion on the front surface to interdigitated contacts on the back surface. We report on progress towards demonstration of two concepts for the EWT cell. The first EWT concept uses a fabrication sequence based on heavily diffused grooves and plated metallizations, and the second EWT concept uses a single furnace step and screen-printed metallizations. We also report on demonstration of double-sided carrier collection in the EWT cell.

1406 Photovoltaic Power Systems

Refer also to citation(s) 21135, 21186, 21191, 21192, 21227, 21238, 21262, 21890

21201 (CONF-931269–) **1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).** Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The 1993 JSES/JWEA Joint Conference was held on December 9 and 10, 1993. As for solar cells, reports are made on performance of a-Si photovoltaic modules, heightening efficiency of polycrystalline silicon solar cells, and solar cell/capacitor combined devices. As to solar concentration of solar cells, compound elliptic lens and characteristics of cone type concentrators are reported. With regard to the photovoltaic power generation system, described are results of solar house operation and eco energy house power generation. Relating to heat storage, mentioned are a design method of the seasonal thermal storage system using water as a medium and the optimal control of the ground thermal storage system. As to heat pumps, the paper states an analysis of an exothermic reactor on the solar chemical heat pump system, and a hybrid heat pump system using panels with photovoltaic modules as evaporator. In addition, a wind powered generation system for weather observation robot, and a floating wave power device are described.

21202 (CONF-931269–, pp. 1-4) **Field research on thermal environment and energy consumption of the house with solar air conditioner.** Kimura, K. (Waseda University, Tokyo (Japan)); Fukumitsu, W.; Lee, E.; Udagawa, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

A field research was carried out on the thermal environment and energy consumption in a personal house equipped with 'PV Air Conditioner' that works on solar cells. The southern side of this house has no shielding for sunshine and the roof is installed with a 500Wp solar cell assembly. The PV air conditioner system is operated with two lines of power sources: commercial 100V power and solar cell, which are combined for their optimal use in accordance with the power load and the amount of solar radiation. This system is provided with no storage batteries and mainly used for daytime peak cut. Actual measurement showed that power consumption of the PV machine was maximum in summer and about 12% of the daytime demand was supplied by solar cells. However, the solar cells were used often after 14:00 and thereby contributed to the peak cut not so much as expected. In winter, they are used frequently around 8:00, causing the amount of solar radiation to be used effectively. Compared with 11.4% of the conversion efficiency of solar cells announced by the maker, the practical conversion efficiency obtained by using the mean data per hour in summer was 9.3%. 13 figs., 3 tabs.

21203 (CONF-931269–, pp. 2-1-2-6) **Solar energy conversion for electricity in Korea.** Lee, T. (Korea Institute of Energy Research (Korea, Republic of)); Cho, S.; Son, B. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The developmental program of photovoltaic power generation (PV) in Korea is outlined. The program is composed of (1) the phase 1 (1989-1991) including development of mass production technologies for low-cost efficient crystalline Si solar cells, performance improvement of inverters and lead-acid batteries for PV systems, and field tests and standardization of stand alone systems for remote islands, (2) the phase 2 (1992-1996) including development of production technologies for large reliable amorphous Si solar cells, development of advanced batteries for PV systems, and establishment and standardization of test and evaluation systems, and (3) the phase 3 (1997-2001) including development of production technologies for low-cost efficient thin film solar cells, and field tests and standardization of grid-connected systems. In order to achieve the technical goals of the phase 1, 27 subprojects were promoted with the input of nearly US$ 8.4 million funding, and the results of the phase 1 were confirmed by demonstration test using the 63 household-scale 90 kWp PV system installed in a remote island in Jan. 1993. 1 fig., 3 tabs.

21204 (CONF-931269–, pp. 5-8) **Performance of a-Si PV module under outdoor condition and its analysis.** Ota, H. (Fuji Electric Corporate R and D Ltd., Tokyo (Japan)); Sichanugrist, P.; Hama, T.; Ichikawa, Y.; Sakai, H. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Comparison in actual operating conditions was carried out between amorphous silicon (a-Si) and crystalline silicon (c-Si) and its results were reported. The rated conversion efficiencies of tested solar cells at a standard condition are 7.8 in a-Si and 12.0 in c-Si. The ratio of the amount (Wh/m^2) of power generation of a solar cell per day to the amount of total solar radiation (Wh/m^2) a day is defined as 'mean efficiency' and was used. As a result of measurement in the period from April to September, it was found that the mean efficiency in a-Si is roughly constant in the vicinity of the rated efficiency irrespective of date and time, but that in c-Si lowers about 2% from the rated efficiency in summer. It was also found from the measured values of spectral distribution of solar radiation and the spectral sensitivity characteristics of solar cells that the significant gap from the rated efficiency in c-Si solar cells may be caused by the seasonal change of the solar spectrum. It was found that not so much difference in efficiency in terms of mean efficiency occurs between a-Si solar cell and c-Si solar cell as in rated efficiency. 1 ref., 5 figs., 5 tabs.

21205 (CONF-931269–, pp. 9-12) **Fabrication and characterization of solar cell/capacitor combined device.** Yamada, Y. (Tokyo Denki University, Tokyo (Japan)); Sunabara, T.; Mino, K.; Fujinaka, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

A solar cell/capacitor combined hybrid element was fabricated to estimate its characteristics. The capacitor of the hybrid element is an electrical double layer capacitor whose activated-carbon electrode is permeated with a NaCl aqueous solution as electrolyte. The static capacitance of the capacitor is about 129F and the solar cell has a size of 100×100mm. By the combined use with solar cell, capacitance increase due to temperature rise is expected. As a result of measuring the changes in load voltage due to the ON and OFF operations of a simulated light source and irradiation of actual solar radiation, a comparatively stable output was obtained in the hybrid element compared with the case of solar cell only. Besides, the hybrid element continued to issue output even after the sun set and the output of the solar cell was exhausted. A mini-solar car mounted with this element was verified to have sufficient milage. Because rapid charge is possible in this element, storage of electrical energy regenerated from the motor of electric car is expected. 5 refs., 8 figs.

21206 (CONF-931269–, pp. 13-16) **High efficiency polycrystalline silicon solar cells.** Machida, T. (Sharp Corporation, Osaka (Japan). Energy Conversion Laboratories); Nishida, M.; Nakaya, H.; Moriuchi, S.; Nunoi, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

For the purpose of producing high efficiency solar cells, reduction of surface reflectance and depth of junction in the cells with the use of polycrystalline silicon substrate was carried out and the results of experimental manufacture were reported. In the method where the surface of a polycrystalline silicon substrate is made low in reflectance by being machine-processed to form a number of ditches, a beveled blade was used to change the conventional U-shaped cross section to V-shaped one. It was found that the acid etching process gives deep ditches whose apex angle is acuter, maintaining the shape immediately after processing as the etching time is made shorter. The conversion efficiency was maximized when a blade having an apex angle of 40 degrees was used. The depth of junction was examined so as to effectively utilize energetic short-wavelength light. As the results, conversion efficiency was improved in the junction shallower than the conventional one and having a sheet resistance of 72 ohms. Thus high efficiency cells were experimentally manufactured and a highest conversion efficiency of 17.2% in the past was obtained by introducing the above results and using polycrystalline silicon substrates of 10cm square prepared by the cast method. 3 refs., 7 figs., 1 tab.

21207 (CONF-931269–, pp. 17-20) **Solar-EV ran the distance of Tokyo-Osaka (1200Km).** Fujinaka, M. (Tokyo Denki University, Tokyo (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports the result of a long-distant travel test on electric cars equipped with solar cell panels. Comparison is made of energy consumption, etc. between electric cars made by remodeling light-gasoline cars and gasoline cars that travel side by side a distance of abut 1200 km between Tokyo and Osaka (a round trip). They went at an average speed of 50 km/h and returned at 70 km/h. The electric car was charged about 10 kWh at night and about 1 kWh during the day from the commercial power source. As a result, average distance is 7.5 km/kWh from calculating it with average loss as 20% considering the rectifier instrument and efficiency of storage battery. The actual power consumption is 164 kWh, which corresponds to 4100 yen in commercial power rate and 41 l in heavy oil. Gasoline consumption and fuel cost of a light gasoline car are 68 l and 8160 yen, respectively, which corresponds to around 90 l in heavy oil if making an oil refining/transportation cost 25%. When charging through the solar station becomes possible, electric vehicles will be more advantageous. 6 figs., 1 tab.

21208 (CONF-931269–, pp. 45-48) **Study of PV module simulator.** Nakashima, T. (Nishimu Electric Industrial Corporation, Fukuoka (Japan)); Nishimoto, T.; Koga, T.; Ogawa, H. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports on a simulator prepared to estimate output of a solar cell and simulate its characteristics. Because in developing a peripheral system such as a photovoltaic inverter it is impossible to connect solar cell modules that are affected by insolation and temperatures, a simulating device has been fabricated. The device can provide characteristics that approximate outputs from the solar cell modules by controlling a direct current source and static induction transistors. The simulator has a function to input spot or continuous insolation and module temperatures and output them on a display, and a function to output statistically the outputs from the solar cell modules according to each element by referring to specific data. The device was used to predict the input range of a solar light inverter for 5-KWp solar cell arrays, or estimate cumulative time and cumulative power generation amount by each optimal operation voltage for the solar cell arrays from a record of continuous insolation amount. In addition, its maximum power tracking function was verified. 5 refs., 10 figs.

21209 (CONF-931269–, pp. 53-56) **Development of blocking relay.: For high efficiency PV system.** Nanno, I. (Omron Corp., Kyoto (Japan)); Tsuji, H.; Hayashi, E.; Tsurukawa, Y. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to improve power generation efficiency in a photovoltaic power generation system, a blocking relay was developed. The conventional blocking diodes generate power loss of about 1.4 W in a 50-W photovoltaic power generation system, for example. Because the loss in blocking diodes is a product of power generating current and diode voltage drop, a blocking relay was devised, in which the parts are replaced automatically with ones with smaller voltage drop at a current above a certain value. The device leads to a calculation that the power loss can be reduced to about 23%. As a result of the comparative experiment in a 50-W photovoltaic power generation system, the power loss in a blocking relay was reduced to about 21% of that with a blocking diode. A photovoltaic power generation system applied with the

blocking relay is expected to have the generation efficiency increased by 4% in a 100-W system. A 3-KW system was evaluated to be benefited more by the effects of eliminating heat dissipating plates and in-board ventilation rather than from the effects of improved power generation efficiency. 2 refs., 7 figs., 5 tabs.

21210 (CONF-931269–, pp. 57-60) **Study on total solar systems. part 8.: Field measurement of the performance and simulation of the solar photovoltaic systems.** Kanematsu, T. (Chubu University, Aichi (Japan)); Okumiya, M.; Nakahara, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Performances of different components in a solar power supply system in a solar house were identified from operation and measurements of the system, a simulation programs was prepared, and an optimal design was discussed. Against a maximum power generation efficiency of 12% in a solar cell, the measurements have indicated it 9.6% to 10.2% as a result of balancing with the batteries and inverter. While the inverter efficiency has remained nearly constant at about 80% under a load factor of 40% or higher, the efficiency has dropped sharply under a load factor of lower than 40%. Accuracy of the simulation on the solar power supply system was discussed according to the measurements of insolation, ambient temperatures, and power loads. As a result, good data were obtained in the output characteristics of the solar cells, charge/discharge current and charge factor for the batteries. Discussions were given on the accuracy of the simulation for the power supply system based on power load obtained from heat side calculations using climatic data. A nearly reasonable result was obtained in a comparison with the result of measurements for five days, although there have been some deviations in room temperatures and tank water temperatures. 2 refs., 12 figs.

21211 (CONF-931269–, pp. 61-64) **Indoor environment and result of generation in 'eco energy house'.** Ishikawa, O. (Misawa House Institute of Research and Development Co. Ltd., Tokyo (Japan)); Kurihara, J.; Ida, H.; Iijima, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper introduces a residential experiment on an energy saving house utilizing photovoltaic cells (Eco Energy House). This house is of a high heat insulating and airtight construction, mounting photovoltaic modules with a total output of 6.1 kWp on its roof. While a room temperature during winter can go down to 10°C in early morning in a house with ordinary heat insulating specifications and without room heating, an Eco Energy House maintained it at about 20°C. A comparison in terms of annual air conditioning load indicated that the Eco Energy House can maintain a room temperature for pleasantness of an identical degree with an energy of about 1/10 of that required in ordinary houses. According to a record of an Eco Energy House in which the family of 'I' lives actually, kept between November 1992 and August 1993, about 1/3 of the total energy consumption has been supplied from the photovoltaic power generation. The cause for consuming more power than a simulation was inferred that more energy has been consumed for such requirement that does not relate to house performance as hot water supply and lighting. 10 figs., 2 tabs.

21212 (CONF-931269–, pp. 77-80) **New islanding prevention (active) and its characteristics.** Okado, C. (Toshiba Corp., Tokyo (Japan)); Kimoto, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Discussions have been given on a new active islanding prevention system in a system for interconnection with a low voltage power line system of photovoltaic power generation. The conventional systems are incapable of making effective prevention because detection and protection functions will not operate and create an insensitive band if active and inactive powers in a load are balanced with those in inverter output. Therefore, a slip mode frequency shifting system was developed, in which phase angles in inverter current are designed in special curves, and the frequency operating in islanding is shifted to a stabilization point of either f_1 or f_2. According to a calculation, the frequency has dropped by about 2 Hz in an islanding operation with a load in a leading inactive power of about 0.01% against the active power. In the case of small lagging power factor, the frequency has risen by more than 2 Hz. In either case the frequency has been stabilized in as short a time as about 0.2 second. As a result of an experiment, the frequency during an islanding operation rises in the case of an inductive load, and drops in the case of a capacitive load. The time for the frequency to change by 1 Hz was within 0.2 second in either case, exhibiting sufficient protective function. From the above findings, the new slip mode frequency shifting system was found very effective as an islanding preventive measure without an insensitive band. 2 refs., 11 figs.

21213 (CONF-931269–, pp. 81-84) **Temperature coefficient dependent on irradiance.** Hirata, Y. (Science University of Tokyo, Tokyo (Japan)); Akahane, O.; Tani, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Discussions have been given using measurements on the temperature coefficient of photovoltaic cell arrays, an important element in designing a photovoltaic power generation system. The measurements have been performed with polycrystalline silicon and amorphous silicon photovoltaic cell modules, a thermocouple, a pyranometer, and a spectroactinometer placed on a roof at an inclination of 35.5 degrees in the due south direction. The measurement data acquired during January and September 1993 were classified by irradiance to investigate the solar beam spectral distribution and the temperature coefficient according to each classification. As a result, the effective spectral ratio and the short circuit current tend to increase, and the maximum output and the release voltage decrease as the cell temperature rises. In addition, inclination in the effective spectral ratio tends to increase and the temperature coefficients for the maximum output and the short circuit current grow larger as the irradiance decreases. The temperature coefficient for the release voltage remains nearly constant against the irradiance, and is not affected by the solar beam spectral distribution. 3 refs., 6 figs., 3 tabs.

21214 (CONF-931269–, pp. 85-88) **Transmission of solar module coverglass.: Influence of output on environmental exposure and dust.** Kori, K. (Science University of Tokyo, Tokyo (Japan)); Hirata, Y.; Tani, T.; Nakai, H. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number

DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Discussions have been given on influence of contamination of coverglass placed on photovoltaic cell modules due to air pollution upon transmission, and further upon the output. An outdoor exposure experiment on glasses simulating the modules selected an ordinary plate glass, a quartz glass, and a silica coated glass to measure spectral transmission after exposure. Reduction in the transmission showed a nearly identical trend that identifies the accumulation of dust being a prevailing factor. This result was applied to cover glasses for amorphous silicon, polycrystalline silicon and monocrystalline silicon photovoltaic cell modules to discuss their influence on output. As a result, it was found that the amorphous photovoltaic cell has its wavelength band of spectral sensitivity in a low wavelength band, and has a relatively large loss due to contamination, and that the quartz glass has the least loss among the coverglasses. In any of the cases, the loss was concluded to reach 5% or more of the total power generation amount if the operating life of photovoltaic cells is assumed ten years. 4 refs., 14 figs., 3 tabs.

21215 (CONF-931269–, pp. 97-100) **Analysis on performance of PV-array I-V curve tracer by the capacitive load method. Vol 4.** Kawai, H. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Horigome, T.; Kurokawa, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports a characteristics calculation method effective in noise suppression in an on-site characteristics test of photovoltaic cell arrays. While the characteristics measurement uses a capacitive load type I-V curve tracer, it requires deriving a maximum output operation point with high accuracy. For this purpose, a parameter verification method and an index function approximation method were introduced that use approximate calculations simplified of the I-V curve characteristics equation. This method that uses all of the data offers such benefits that allow high noise suppression effects, easy complementation, and taking the sampling time interval long. This method as applied to the measurement data acquired in March 1993, and calculation of the maximum output was attempted. The result showed that the application success rate was 60% or more in fine weather days when the parameter verification method was used independently, about 80% regardless of weather when the index function approximation method was used. Monthly average value was 41.6% with independent use of the parameter verification method or 78.4% with both methods combined, partly because of more number of cloudy days. 5 refs., 7 figs.

21216 (CONF-931269–, pp. 101-104) **Scaled-up dialytic battery with ion-exchange membrances for the solar membrance cell.** Suda, F. (Tokai University, Tokyo (Japan)); Iwadate, T.; Nagasawa, H.; Fukuda, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

An experimental study has been made on characteristics of a dialytic battery for the purpose of developing a solar membrane cell to store solar energy as energy differential between sea water concentrations. An experimental equipment for the dialytic battery consists of 101 fresh water and sea water compartments partitioned by 50 anionic and cationic ion-exchange membranes to allow the fresh and sea waters to flow into the compartments alternately. As a result of the characteristics test, the dependency of the open circuit voltage on fresh water flow rate showed saturation curves. It was made clear that the open circuit voltage is in proportion with the logarithm of concentration ratio of the sea water to the fresh water, and that the governing factor for internal resistance in the dialytic battery is a resistance in the fresh water. It was shown that the output power gets maximized when load resistance has matched the internal resistance. It was also found that the open circuit voltage increases in proportion with size increase in the dialytic battery, that is increase in the number of the ion-exchange membrane pairs, and that the output power has its peak position shift to the side with smaller internal resistance and load resistance, resulting in increase in the maximum value. 8 refs., 7 figs., 1 tab.

21217 (CONF-931269–, pp. 165-168) **Studies of direct expansion type solar heat pump.: Case when radiative type evaporator With flexible photovoltaic modules are used on the surfaces.** Ito, S. (Kanagawa Institute of Technology, Kanagawa (Japan)); Miura, N.; Wang, Q.; Nishikawa, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to improve efficiency of a heat pump used for air conditioning and hot water supply, discussions have been given on effects of photovoltaic modules on the heat pump performance by using a heat collector cemented with photovoltaic modules. Installing a radiative evaporator with the rear of the panel heat-insulated, and a convective evaporator with good convective heat transfer, an experiment has been carried out on the case of single installation of each device, and the case of parallel installation of both devices. A compressor had an output of 350 W, and the photovoltaic modules had a total area of 2.45 m^2, which accounts for 76% of the collector surface area. As a result of the experiment, the heat pump has exhibited no difference in performance between uses of the radiative evaporator with solar cells and that without solar cells regardless of whether electric power is generated or not. The heat pump achieved high performance during daytime, but had the performance degraded when the evaporation temperature has fallen to -6°C, lower by 12°C than the ambient temperature. When both evaporators are used in parallel, performance higher by about 50% was obtained than with the radiative evaporator alone when the ambient temperature was about 8°C. 1 ref., 8 figs.

21218 (CONF-931269–, pp. 173-176) **Solar system operation considering a forecast of daily insolation obtained from precipitation probability.** Sugioka, S. (Toyohashi University of Technology, Aichi (Japan)); Kenmoku, Y.; Sakakibara, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports a study on solar light and heat hybrid utilization system used in multiple dwelling houses for its effect of reducing electric power purchase by forecasting daily insolation from precipitation probability. Hourly power load patterns of one year worth were compiled on the facilities subjected to the discussion. A regression line has been obtained from data on hourly insolation, air temperature, daily cumulative insolation forecast, and precipitation probability. Temperature rise in heat storage tanks was calculated by deriving a full-day insolation in the following day to seek the amount of power to be purchased from a utility grid. A method to purchase power from the utility grid evenly over the

months of March, June, September, and December 1988 was compared with a method that incorporates insolation forecasts. As a result, if the power amount purchased using the equal heating method is taken as 100%, the insolation forecasting method has come out as 27% or less. However, while the equal heating method has generated no power insufficiency, the insolation forecasting method has created that of 95.6 kWh in March, and 209.9 kWh in September. 4 refs., 3 figs., 3 tabs.

21219 (CONF-931269–, pp. 221-224) **Study on optimum use of solar thermal and PV systems in residential houses.** Udagawa, M. (Kogakuin University, Tokyo (Japan)); Endo, T.; Murata, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This report describes the results of experimental simulation of a solar house with a hot-water supply system utilizing solar radiation and an optical power generation system. The model house used for simulation, located in Tokyo, is a wooden house with a high insulation design having a total floor area of 149m^2 and a wellhole space. The residents are a four-member family of a couple and two children. The hot-water supply system is an indirectly heated, forced circulation system with an auxiliary gas heat source. The optical power generation system is system-interconnected and, in case of power deficiency, it can be assisted by commercial power. A simulation program EESLISM was used for simulating the warming condition in the house, energy consumption for air-conditioning and hot-water feeding load of the solar-heat utilized hot-water feed system and was integrated with a simulation program of the solar light power generation sysytem with system interconnection. When the area of solar cells is made wider than 10m^2, the reverse tidal current also increases. However, power supply remains unchanged, and the area of 20m^2 is sufficient even in the peak time in summer. The hot-water supply system is small-sized and effective. 5 refs., 10 figs., 4 tabs.

21220 (ECN-C–93-092) **Operation principles and some test results of inverters for grid connected PV systems: Part 1: Operation principles of inverters and MPPT's for grid connected PV systems, and Part 2: Results of an experimental comparative analysis of the Fraunhofer inverter and the TUE-IGBT inverter.** De Haan, S.W.; Veltman, A.T. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Dec 1993. 50p. Contract NOVEM 41.250-002.1 and 41.250.0091.01 (partially report Order Number DE94774376. Source: OSTI; NTIS; Available from the library of the Netherlands Energy Research Foundation (ECN), P.O. Box 1, 1755 ZG Petten (Netherlands).

The work described in this report is part of the Research and Development Programme NOZ-PV (Netherlands Research Program on Solar Energy and Photovoltaic Energy) of the Netherlands Agency for Energy and the Environment (NOVEM).

In the first part of this report three main categories of inverters are distinguished: line commutated converters, self-commutated converters without high-frequency transformer (possibly equipped with a low-frequency transformer) and inverters with high-frequency transformer. In the low power range (up to 3 kW) the inverters with high frequency transformer are increasingly popular. The line commutation principle seems to be more suited for higher power application (> 10 kW). In part 1 also four different operation principles for MPPT integrated in inverters are described. In the second part test results and results of a comparative analysis of two remaining types of inverters, i.e. the Fraunhofer inverter and the TUE-IGBT inverter (developed by the Eindhoven University of Technology) are presented. Although the properties of the TUE inverter are quite acceptable, the inverter does not seem to have advantages in comparison to other types of inverters without high-frequency transformer. 18 figs., 2 tabs., 15 refs.

21221 (ENEA-RT-ENERG–92-04) **Method to size photovoltaic arrays for hydrogen-PV stand-alone power stations.** Barra, L. (ENEA, Casaccia (Italy). Area Energetica); Coiante, D. ENEA, Casaccia (Italy). Area Energetica. Nov 1993. 30p. (RT/ENERG–92-04). Order Number DE94775328. Source: OSTI; NTIS (US Sales Only).

With reference to a stand alone power plant configuration, a photovoltaic (PV) system, integrated with an electrolytic hydrogen production and fuel cell reconversion line, is examined with the aim of checking the possibility of assuring energy supply for a given load with time continuity. In order to size the PV array in function of the annual load diagram, for a given site, a method, which utilizes the monthly average values of sun energy density collected on horizontal surface as input data, is presented. The results demonstrate that a PV-H_2 system is suitable for a modular stand alone solar power station, able to supply continuously each generic load. This technical acquisition has to be considered as the first necessary condition to get photovoltaics to overcome the limit due to working intermittence and become a real energy option. An example of an application for a small Mediterranean island, the Volcano Island, permanently inhabited by 469 people, is also discussed. This typical case can be actually show the technical viability of the PV-H_2 solution in powering a small community with the required reliability.

21222 (NREL/TP–411-6406) **US manufacturers of commercially available stand-alone photovoltaic lighting systems.** McNutt, P. National Renewable Energy Lab., Golden, CO (United States). May 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006917. Source: OSTI; NTIS; GPO Dep.

This report introduces photovoltaic (PV) lighting systems, gives some specifications for ordering these systems, and provides a list of some of the manufacturers of these systems in the United States. These PV lighting systems are all commercially available. They are stand-alone systems because they are not tied to the electric utility power grid.

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21223 (CONF-931269–, pp. 89-92) **Conceptual consideration on PV systems for advanced regional energy-supplying activity 'PV-AREA'.** Kurokawa, K. (Electrochemical Laboratory, Tsukuba (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper presents a conception of the regional energy supplying system (PV-AREA) as a utilization form compatible with features in a discrete type photovoltaic power generation system. The photovoltaic power generation system is characterized by being an energy supply system closely connected with regional communities, and capable of location even in areas with no utility power system available. The PV-AREA is divided largely into a centralized arrangement and a discrete arrangement. The case of the centralized arrangement requires securing land for the arrays as a prerequisite. Specifically, desert areas blessed with insolation conditions in developing countries are assumed. Their potentiality is as large as they can take care of the world energy requirement. The most critical assignment for this case is the cost reduction in a total term. The discrete arrangement assumes existing towns and villages, suburban communities, and industrial complexes, of which total amount of power generation can grow as large as it can not be ignored. This case requires discussions on levelling of load profiles and power generation profiles in relation with the community services. 3 refs., 5 figs., 1 tab.

21224 (DOE/EA–0911) **Proposed solar two project Barstow, California.** USDOE Golden Field Office, CO (United States). Jan 1994. 55p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013082. Source: OSTI; NTIS; GPO Dep.

This Environmental Assessment (EA) evaluates the environmental consequences of the proposed conversion and operation of the existing Solar One Facility in Daggett, Ca, near the city of Barstow, to a nitrate salt based heat transfer system, Solar Two. The EA also addresses the alternatives of different solar conversion technologies and alternative sites and discusses a no action alternative. A primary objective of the Solar Two Project is to demonstrate the technical and economic feasibility of a solar central receiver power plant using molten salt as the thermal storage and transport fluid medium. If successful, the information gathered from the Solar Two Project could be used to design larger commercial solar power plants.

21225 (SAND–93-1251) **On-sun test results from second-generation and advanced-concepts alkali-metal pool-boiler receivers.** Moreno, J.B.; Andraka, C.E.; Moss, T.A.; Cordeiro, P.G.; Dudley, V.E.; Rawlinson, K.S. Sandia National Labs., Albuquerque, NM (United States). May 1994. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011243. Source: OSTI; NTIS; GPO Dep.

Two 75-kW_t alkali-metal pool-boiler solar receivers have been successfully tested at Sandia National Laboratories' National Solar Thermal Test Facility. The first one, Sandia's " second-generation pool-boiler receiver," was designed to address commercialization issues identified during post-test assessment of Sandia's first-generation pool-boiler receiver. It was constructed from Haynes alloy 230 and contained the alkali-metal alloy NaK-78. The absorber's wetted side had a brazed-on powder-metal coating to stabilize boiling. This receiver was evaluated for boiling stability, hot- and warm-restart behavior, and thermal efficiency. Boiling was stable under all conditions. All of the hot restarts were successful. Mild transient hot spots observed during some hot restarts were eliminated by the addition of 1/3 torr of xenon to the vapor space. All of the warm restarts were also successful. The heat-transfer crisis that damaged the first receiver did not recur. Thermal efficiency was 92.3% at 750°C with 69.6 kW_t solar input. The second receiver tested, Sandia's "advanced-concepts receiver," was a replica of the first-generation receiver except that the cavities, which were electric-discharge-machined in the absorber for boiling stability, were eliminated. This step was motivated by bench-scale test results that showed that boiling stability improved with increased heated-surface area, tilt of the heated surface from vertical, and added xenon. The bench-scale results suggested that stable boiling might be possible without heated-surface modification in a 75-kW_t receiver. Boiling in the advanced-concepts receiver with 1/3 torr of xenon added has been stable under all conditions, confirming the bench-scale tests.

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Refer also to citation(s) 20709, 21185, 21195, 21200, 21216, 21217, 21218, 21248, 21252, 21253, 21254, 21255, 21256, 21257, 21749, 21751, 21891, 22520

21226 (CONF-931269–, pp. 1-1-1-8) **R and D of solar architecture in Korea.: Past, present, and future perspectives.** Lee, K. (Korea Solar Energy Society (Korea, Republic of)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The trend of R. and D. was reviewed for solar architectures in Korea. Research on solar architectures in Korea started after the first oil crisis in 1973, and research on passive solar heating was mainly promoted by Korea Institute od Energy and Resources (KIER). Passive solar systems were widely adopted for classrooms more than 1,600 indicating reasonable results, however, their construction rapidly decreased since 1988 because of the lack of incentives to save energy and poor training of architects. On the other hand, active hot water supply units rapidly increased since 19 3 resulting in 3,000 installations in 1990. Most universities have no explicit teaching in solar architectural design, and a few universities study some projects such as passive solar design for Korean traditional architectures. Various projects such as 1 MW class solar thermal power generation, 1 MW class photovoltaic power generation and large scale solar district heating have been planned for the future development. 8 refs., 6 figs., 2 tabs.

21227 (CONF-931269–, pp. 41-44) **New utilization methods of solar energy.** Kitami, T. (Central Research Institute of Electric Power Industry, Tokyo (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper introduces 'light intensification into luminous flux to obtain super-high intensive beam of luminous flux from solar light intended of solar light utilization. The conventional light intensification has been determined basically by a ratio of areas before and after light concentration. The present method is to have a light draw a loop to increase the light intensity by superposing temporally different lights including the very light itself. A conceptional light flux intensification system for solar light consists of a light concentration part to concentrate the solar light to turn it into beam, a convergence part and a light flux intensifying part to further intensify the light flux, and an out put part. At the outlet, lights of which fluxes have been intensified are taken out continuously from the outlet hole disposed on a region in one end of the closed loop in the light flux intensifying part. Utilization potentials of the flux-intensified light include a heat source for manufacturing hydrogen by using a direct water pyrolytic process, a plasma substitution for such processing dy welding, cutting, and spraying, reduction and refining of metals, and decomposition and disposal of harmful wastes, or an excitation source for laser nuclear fusion reaction. 14 refs., 3 figs., 1 tab.

21228 (CONF-931269–, pp. 105-108) **Improvement in the performance of air type solar house system with proportional control for collector air flow rate.** Koizumi, H. (Asahi Solar Corp., Hiroshima (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to improve solar heat utilization rate in a solar system, an experiment has been carried out on air flow control in an air heat collecting solar house. The experiment has been performed by installing sequentially on the solar house a constant air flow heat collecting system, an air flow control according to heat collected air outlet temperatures, and a variable air flow system using a photovoltaic cell driven fan. As a result of the measurement, a comparison of efficiencies of the constant air flow system and the variable air flow heat collecting system in fine weather days showed a considerably higher efficiency in the variable air flow system. The cause for the lower efficiency in the constant air flow system was determined to be lower insolation leading the heat collecting fan to repetition of operation and shutdown, or bringing the heat collector temperature too high if insolation is high. The photovoltaic cell driven system, which is also a variable air flow system, has a problem that the maximum air flow cannot be increased much in a simple direct drive because of too little air flow variation for change in insolation. Nevertheless, the number of start and stop of the heat collecting fan in the morning and in the evening is three to five times, giving by far higher effect than in the constant air flow system. 14 figs., 4 tabs.

21229 (CONF-931269–, pp. 109-112) **Fundamental composition of solar heating and adsorption cooling system for living house.** Okamoto, Y. (Ibaraki University, Ibaraki (Japan). Faculty of Engineering); Iwasa, Y.; Inagaki, T.; Niwa, T.; Okumura, A. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports a solar cooling and heating system for a living house utilizing silica-gel adsorbents. The system consists of solar roofing collectors, adsorption and desorption columns, an underfloor concrete heat storage tank, a heat exchanger, and a hot water storage tank. Air taken into the system from a duct installed at the rear of the solar roofing collectors is heated by solar energy admitted onto the roof face to 100°C or so in summer and 60°C in winter. During room cooling operation in the summer season, the adsorbents adsorbed water in rooms are desorbed and dried by the high-temperature air, and hot water is also supplied. Cooling water from the cooling coils is cooled and its heat is dissipated into water welled up from a depth of 30 m. According to the measurements of a passive solar house in the city of Kushiro, Hokkaido, installed with a solar energy room heating system, the room temperatures were from 17°C to 20°C when the ambient temperature changed from 0°C to -7°C. This condition is comparable to an ordinary house in the north Kanto area, where room temperatures were from 3°C to 20°C when ambient temperatures were from 0°C to 16°C. 3 refs., 6 figs., 3 tabs.

21230 (CONF-931269–, pp. 145-148) **Studies on temperature selective heat storage tank. Part 5.: Drawing out model and design of drawing out sub-tank.** Kamiya, Y. (Kanto Gakuin University, Tokyo (Japan)); Kurihara, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Experimental studies have been carried out on a temperature selective heat storage tank for the purpose of recovering waste heat with large temperature variation and utilizing solar heat. The experimental device is a water tank with a height of 150 cm, a width of 40 cm, and a length of 100 cm, disposed with a sub-tank attached with a damper switch and dampers. In the experiment, such a temperature distribution was formed that a temperature changing region comes between the first damper and the second damper, and a measurement was made on a maximum flow rate that can be drawn out from only the first damper, but not from the second damper. The result of the measurement showed an approximate agreement with the value of a calculation model for a limited drawout. Design of the temperature selective heat storage tank requires the following matters to be considered as critical points: a cross section area of the sub-tank should be larger than the effective passage area in the dampers; the dampers should be spaced at approximately the thickness of the temperature changing region; the shaft should have a long travelling distance in order to make the passage area at the openings large enough; and the temperature sensors should be placed at the upper damper position for the upper part draw-out, and at the lower damper position for the lower part draw-out. 4 refs., 9 figs., 1 tab.

21231 (CONF-931269–, pp. 149-152) **Study on characteristics of distillation process in transient and steady state in solar chemical system.** Aoki, H. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Horigome, T.; Doi, T.; Tanaka, T.; Fujii, T.; Takashima, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

A study has been carried out on a chemical heat pump to raise low temperature solar heat by utilizing chemical reactions for the purpose of utilizing solar energy more effectively. A reaction utilized in the chemical heat pump is endothermic and exothermic reactions between 2-propanol and acetone + hydrogen. In order to identify motional characteristics of the generated acetone when it is separated in a distillation column, analyses and calculations have been performed on its flow rate and composition in the distillation column in a transient condition. As a result, the following matters have been made clear: the steady state value remains unchanged even if filling material is changed; increased heat supply results in increased effluent flow rate, but increases evaporation of 2-propanol, and decreases acetone concentration; increasing the reflux ratio can raise the acetone concentration in the effluent, but reduces the amount that can be drawn out; and, therefore, in order to obtain as much amount as possible from the effluent with the same composition, it is necessary to increase the heat supply as well as to raise the reflux ratio. 2 refs., 7 figs., 1 tab.

21232 (CONF-931269–, pp. 169-172) **Evaluation on performance of a thermal core type heat storage system in soil utilizing solar heat. Part 2.: Discussions no factors influencing system performance.** Nakajima, Y. (Kogakuin University, Tokyo (Japan)); Yoshida, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

In designing a solar heat utilizing air conditioning system by using thermal core type heat storage in soil, discussions have been given on effects of system constituting factors on the system on the whole. Variable factors selected in the model were heat collecting area and insolation absorbing rate for the heat collecting section; heat storage tank capacity and area of contact between the heat storage tank and soil for the heat storing section; and capabilities of room heating devices for the heat recovering section. The system performance was discussed on energy consumption, system COP, solar energy utilization rate, and energy consumption reducing rate. As a result, the following matters were indicated: increase in the heat collecting area reduces the energy consumption in the system, but no energy saving effect can be obtained if the heat collecting area is smaller than 7.68 m^2; increasing the heat storage tank capacity improves the thermal efficiency in the room heating system, proving the solar heat being utilized effectively; and improvement in heat pump performance affects the system performance greatly. A single factor giving the largest effect on the system performance was the size of the heat collecting area. 3 refs., 19 figs., 3 tabs.

21233 (CONF-931269–, pp. 177-180) **Utilization of sky radiation energy for space cooling/water chiller system.** Saito, S. (Tohoku University, Sendai (Japan). Faculty of Engineering); Yanamoto, Y.; Shinomiya, J. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Analyses and studies have been given on a natural energy autonomous house intended of thing care at nearly 100% of power required for air conditioning by utilizing solar energy and sky radiation cooling. The analyzed model is a sky radiator system attached with a polyethylene cover to permeate infrared rays. A seasonal chilling simulation was used to discuss effectiveness of the system. Difference between the case a cover is attached and the case the radiator face contacts directly the atmosphere was noticed, and a comparative discussion was given on their cooling capabilities. As a result, the case without a cover showed a large temperature drop due to the convectional heat transfer up to early April, and the cooling amount has decreased after May. The case with a cover was found less susceptible to effects of the atmosphere, keeping the cooling capability down to about the end of May because of cooling caused from radiation. Therefore, the cover has been removed during the period up to early April, and it has been attached thereafter, where a result was obtained that more cold heat has been stored. 10 refs., 6 figs., 1 tab.

21234 (CONF-931269–, pp. 181-184) **Simulation of solar domestic hot water heating system with component model method.** Udagawa, M. (Kogakuin University, Tokyo (Japan)); Murata, T.; Endo, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper proposes a component model method intended of preparing programs rich in versatility and expansibility for simulating a solar domestic hot water beating system. The paper also shows examples of simulation on a hot water supply system. The component calculation model expresses as a steady state the relation between inlet and outlet temperatures and calorific power at the forward piping and the backward piping in the hot water supply system consisting of solar heat collectors with selective absorption membranes, and heat storage tanks. The heat storage tanks are applied with a completely mixed tank array model in which the actual tanks are split into several completely mixed tanks, and the temperature distribution is expressed by linking them. A simulation example is referred to a case with a heat collector area of 5.85 m^2 and a heat storage tank capacity of 300 liters. In this case, a hot water supply schedule has been established, and calculations using the standard meteorological data for HASP have been carried out under an assumption that heat collection is performed when difference between temperatures of the lowermost tank in a heat storage tank and ambient temperatures to t collector has reached more than 20°C. It was shown that a complex system can be handled easily. 3 refs., 7 figs., 1 tab.

21235 (CONF-931269–, pp. 185-188) **Evaluation of performance for solar house with Trombe-wall. Part 3.** Nakajima, Y. (Kogakuin University, Tokyo (Japan)); Watanabe, T.; Abe, H.; Yoshida, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Discussions have been given on a simplified method for calculating loads in Trombe-Wall solar house by using actual measurements and simulations. An analysis using heat loss coefficients has revealed that heat absorption and dissipation of a Trombe-Wall varies the heat loss coefficients, and the heat absorption and dissipation of the Trombe-Wall is governed mainly by heat amount required for room heating, insolation, and heat capacity of the Trombe-Wall. An improvement of this condition has been intended by introducing equivalent heat loss coefficients to make evaluations in non-steady states, and a verification on the improvement in relation to actual loads has been made. The heat absorption and dissipation characteristics of the Trombe-Walls have been derived by using data derived from a thermal performance evaluating simulation program for residential houses. As a result, it has been confirmed that loads can be calculated more simply for a solar house having Trombe-Walls according to the climatic conditions and the heat absorption and dissipation characteristics of the Trombe-Walls by using the equivalent heat loss coefficients. It has also been identified that the heat absorption and dissipation characteristics of the Trombe-Walls at a start-up of the auxiliary air conditioning system in the following day may be forecasted by the climatic conditions of the previous day. 3 refs., 12 figs., 2 tabs.

21236 (CONF-931269–, pp. 189-192) **Study on utilizing natural energy for indoor climate control using roof and attic space. Part 4.: Possibility of utilizing the sensible heat of rainwater as the heat source for cooling.** Sunaga, N. (Tokyo Metropolitan University, Tokyo (Japan)); Nishizawa, H.; Ito, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy (December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective of utilizing sensible heat of rainwater as the heat source for radiation room cooling in summer, discussions have been given on summer rainwater temperatures and amount by using measured values and the standard meteorological data. One-minutely measured rainwater temperatures were recorded as average and cumulative values every ten minutes. As a result of the measurements, it was found that the correlation coefficient for rainwater temperatures and wet-bulb temperatures was 0.995, and that the rain water temperatures in summer are equivalent to the wet-bulb temperatures during precipitations. Rainwater temperatures measured at Minami-Osawa in the city of Hachioji in August 1992 and 1993 were 24°C at maximum, and 16°C at minimum, mostly in a range from 20°C to 24°C. Since a temperature on surface of an indoor panel for radiation room cooling could be 25°C on the floor and about 22°C to 25°C on the ceiling, it was made clear that more than half of the rainwater amount can be utilized even in August if rainwater with temperatures lower than 22°C is used. Calculations of wet-bulb temperatures as rainwater temperatures during summer using an annual average meteorological data tend to show results higher than actual temperatures, which poses a problem to be solved in the future. 7 refs., 10 figs., 1 tab.

21237 (CONF-931269–, pp. 225-228) **Compact solar still utilizing a hydrophobic teflon net for separating neighboring wicks.** Oshiro, K. (University of the Ryukyus, Okinawa (Japan)); Tengan, K.; Nosoko, T.; Nagata, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The present report describes an experimental advanced-type solar still. This distillation unit was subjected to an indoor stationary test and a theoretical analysis to clarify its efficiency and heat conduction resistance characteristics. Furthermore, the optimum number of stages and the total yield of distillation in the case where multi-stage type is adopted were calculated to be studied in comparison with the conventional type. The proposal is characterized in a structure where Teflon nets are provided between vaporization wick and condensation wick and the gap between these wicks is set at a quarter of that in the conventional stills. By developing a multi-stage type, the still was miniaturized and the

distillation efficiency was enhanced. As the results, the saline concentration in water distilled by this unit is less than 10ppm and minglement of saline water is negligible. The efficiency and heat conduction resistance of the unit depend on the mean temperature of its thermal flux alone. The efficiency exhibited a value lower than that of the conventional 7mm gas layer by 0.18 at maximum and the reduction of heat conduction resistance is large. This new multi-stage unit has an optimum number of stages 2.25 times as many as that of the conventional units. It is compact and is made 1.57 times higher in distillation yield compared with the conventional ones. The theoretical curve agrees with the measured values. 6 refs., 10 figs., 2 tabs.

21238 (CONF-931269–, pp. 233-236) **Theoretical design of selective emissivity film. 3.: Radiative cooling power of SiO gradient optical index films.** Tazawa, M. (National Industrial Research Institute of Nagoya, Nagoya (Japan)); Yoshimura, K.; Miki, T.; Tai, Y.; Tanemura, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The present report describes the results of computer simulation of inorganic SiO gradient material which is a low-temperature material for utilizing the 'atmospheric window' for the characteristic infrared radiation of 8-13 micron m in wavelength. The gradient material, which is obtainable in large area and whose performance has little dependence on film thickness and wavelength, is a mixture of SiO and air, and its refractive index varies with film depth. Three kinds of gradient material models simulated by multilayer films were prepared for computational use. While the first is a single layer of SiO deposited on an Al substrate, the second and third ones are each prepared by laminating a prescribed number of mixture layers of SiO and air stepwise varied in composition from bottom to top on the same kind of substrate as the first one. The SiO content in the top layer is 60% and 30% in the second and third films respectively. The optical constant of each layer was obtained using Bruggman's uniform film theory. Compared with single layer film, the change of refractive index in laminated films can sufficiently simulate the continuous change of refractive index and the use of gradient material was effective for enhancing radiative power. In the model design, the theory of uniform medium was applied while placing some assumptions on uniformity and surface roughness of film, magnitude of air in the film, interfacial scattering, and change of emissivity. Thus a method of controlling preparation of gradient material having a large area and good radiative power for the characteristic radiation was obtained. 8 figs.

21239 (DOE/AL/20729–T1) **Vaccine refrigerator testing: Final report.** Ventre, G.G. (Univ. of Central Florida, Orlando, FL (United States)); Kilfoyle, D.; Marion, B. University of Central Florida, Orlando, FL (United States); Florida Solar Energy Center, Cape Canaveral, FL (United States). Jun 1990. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC04-82AL20729. Order Number DE94013884. Source: OSTI; NTIS; INIS; GPO Dep.

For the Central American Health Clinic Project initiated in 1986, Sandia National Laboratories and the Florida Solar Energy Center recognized the need for a test and evaluation program for vaccine refrigeration systems. At the Florida Solar Energy Center, side-by-side testing of three photovoltaic powered vaccine refrigerators began in 1987. The testing was expanded in 1988 to include a kerosene absorption refrigerator. This report presents observations, conclusions, and recommendations derived from testing the four vaccine refrigeration systems. Information is presented pertaining to the refrigerators, photovoltaic arrays, battery subsystems, charge controllers, and user requirements. This report should be of interest to designers, manufacturers, installers, and users of photovoltaic-powered vaccine refrigeration systems and components.

21240 (DOE/FTR–94007127) **Travel to Spain for meeting on solar energy systems: Foreign trip report, January 14–24, 1994.** Kutscher, C.F. National Renewable Energy Lab., Golden, CO (United States). 22 Feb 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94007127. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This trip was undertaken to participate in and represent the at US at the International Energy Agency (IEA) Solar Heating and Cooling Program (SHCP) Task 14 workshop. The meeting took place at the Hotel Los Seises in Seville, Spain.

21241 (DOE/FTR–94009740) **Solar Building Analysis and Design Tools, United Kingdom: Foreign trip report, April 1–11, 1994.** Judkoff, R. National Renewable Energy Lab., Golden, CO (United States). 8 Apr 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94009740. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A meeting was held on Task 12, Solar Building analysis and Design Tools, which was approved by the IEA solar Executive Committee in late 1989 after completion of a 1 year feasibility study. the need for Task 12 became evident as a result of activities begun in Task 8, Advanced Solar and Low Energy Buildings. The participants in Task 8 found that the current generation of building energy analysis simulation programs did not have the capabilities to analyze many of the innovative energy design strategies they wished to investigate. They also found that the algorithms used by different simulation codes to model many of the basic mechanisms of heat transfer in buildings, contain a variety of simplifying assumptions which could lead to significant inaccuracies, under strongly solar driven conditions. related studies in Task 8 showed large disagreements between simplified design tools when used to model typical residential structures.

21242 (DTH-LV–94-02) **Danish/Dutch investigation of low-flow solar heating systems.** Furbo, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Feb 1994. 31p. (In Danish). Contract ENS-51181-93.0088. Order Number DE94771130. Source: OSTI; NTIS.

An experimental investigation of four low-flow solar heating systems with differently designed heat storage systems was undertaken in Denmark and Holland. The results of measurements taken are given in detail, mostly in the form of tables illustrating monthly amounts of tapped energy, energy from the electric cartridge, pump energy and total production (which is tapped energy minus the energy related to the electric cartridge). Calculations made by the Danish and Dutch computerized simulation programmes showed that the capacity of the low-flow casing container system was not very much influenced by the size and variations of the heat transfer capacity between the liquid in the solar collector and water in the hot water container if the heat transfer capacity is not too low. The system's production was not much influenced by the content of solar collector liquid in the storage facility or by the location of the control system's temperature probe in the lower part of the casing. The extra capacity of the casing container system in comparison to that of the spiral container will be halved if the length of the heat-exchanger spiral in the spiral container is doubled but the doubling of length will not result in any notable change in the price/capacity relation regarding the spiral-container system. The main reason for the differences in production between the two system types seem to be that in periods of solar collector operation in the spiral container a mixing occurs which breaks down the temperature layering. (AB)

21243 (DTH-LV–94-13) **Development of a computer programme to determine the effect of shadow-casting objects on passive and active solar-heating installations.** Olesen, O.; Stinus, D.; Bidstrup, C. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Mar 1994. 26p. (In Danish). Contract ENS-51181-93.0034. Order Number DE94771123. Source: OSTI; NTIS.

The initial objective of the present project has been to develop a computer programme for the purpose of evaluating the effect of shadow-casting objects. The present reduced version describes a method to determine the effect of shading objects upon the passive

and active solar heating systems - in order to develop a programme in a later stage. The existing methods of shadow evaluation and registration are listed. The planned computer programme would be compatible with those used to simulate shadow conditions, if an adjusted reference year is introduced. Formula for determination of solar incidence per area, regardless of shadow conditions is given and a shadow index for seasonally varying shading objects derived. A programme based on the existing one named SHADOW is proposed. (EG) (10 refs.)

21244 (NEI-DK–1508) **You can always find some sunshine: A report on solar heating systems for consumers of heating and electricity.** De 13 Elselskaber, Horsens (Denmark). Mar 1994. 66p. (In Danish). Contract ENS-51181-92.0003; Contract ENS-51181-92.0068. Order Number DE94771129. Source: OSTI; NTIS.

The aim was to determine potentials for saving by combining electric and solar water heating systems in the homes of typical consumers of heat and electricity. Ten families took part in the experiment which was also covered by the local press. The householders were able to choose the (authorized) solar heating systems themselves and received financial help from the government for the purchase. The systems were professionally installed. Measurements were taken in all cases over a period of twelve months. These gave information on the solar collectors' capacity, the production of electricity and on the consumption of hot water. The families expressed a general satisfaction with the solar heating plants. The amount of energy conservation varied greatly from household to household, but the total figure was 1,600 kWh. It was found that families using large volumes of hot water saved most by additionally utilizing the solar water heating system. Those that used much hot water in the morning had to make use of the electrical heating as at that time the sun wasn't up. It is recommended that solar heating should also be used for washing-up machines and clothes washers and even for floor heating. Solar heating systems have a life service period of 20 years and need little maintenance, so a longer repay period can be accepted. Costs can also be reduced by installing a solar heating system when the electric one no longer functions satisfactorily. Improved thermal insulation and optimization of the control system will also help to reduce costs. (AB)

1410 Solar Collectors and Concentrators

Refer also to citation(s) 21213, 21226, 21228, 21252, 21255

21245 (CONF-931269–, pp. 25-28) **Monte Carlo analysis of luminescent solar concentrators.** Sakuta, K. (Electrochemical Laboratory, Tsukuba (Japan)); Sawata, S.; Tanimoto, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

An analysis using Monte Carlo simulation was performed on a solar luminescence collector intended of utilizing solar energy. The collector was assumed for the calculation purpose that all of the four edge faces has zero reflectance on the output face and the bottom face. Excitation wavelength dependency of fluorescence spectrum and fluorescent quantum was ignored, and the incident light was assumed to be admitted vertically. The result of calculations indicated the following matters: the proportion of fluorescence trapped by full reflection grows larger with the larger the refraction in a medium; with regard to transparency of the medium, a white plate glass costwise available shows noticeable efficiency drop; acrylic resin is equivalent to optical glass; with regard to reabsorption of fluorescent dye as a result of superposition of the dye's absorption spectrum with the fluorescence spectrum, an increase in transfer efficiency can be seen when the fluorescence emitting spectrum is shifted to the longer wave side by 50 nm; and too low a dye concentration reduces the absorption efficiency, and too high the concentration increases the re-absorption, and therefore an optimization is required. 4 refs., 8 figs.

21246 (CONF-931269–, pp. 29-32) **Optimum design of a compound elliptic lens (CEL).** Kobayashi, M. (Tokyo University of Agriculutre and Technology, Tokyo (Japan)); Suzuki, A.; Kobayashi, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

An analysis was performed on output characteristics of a condenser lens intended of utilizing solar energy, by changing permissible incident half-angle of a compound elliptic lens (CEL). The Tokyo and Kumamoto areas were selected for the calculation purpose as locations to install CEL type solar cell modules. Flat-plate type solar cell modules using acrylic resin with identical media as an optical cover were assumed for the purpose of comparing them with CELs. As a result of calculation, it was found that the output from the CELs per unit area reached a maximum at a permissible incident half-angle of 50° and that an optimum value exists for the magnification of condensation because of it decreasing with increasing permissible incident half-angle, whereas the output reaches a maximum at a permissible incident half-angle of 25° if the solar cell area is fixed. It was shown that a CEL type solar cell module can provide an equivalent amount of output with a solar cell area of about 60% of the flat-plate type solar cell module. The Tokyo area was thought to have larger scattering component ratio than in the Kumamoto area, with its output ratio reaching a maximum at an angle of 25° at all times regardless of regional difference in climate. 3 refs., 8 figs.

21247 (CONF-931269–, pp. 33-36) **Optical characteristics of two dimensional cone type-concentrators.** Sato, R. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Suzuki, A.; Kobayashi, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Design and discussion were given on a concentrator with a trapezoidal cross section (2D-CONE) easy of manufacturing in non-tracking concentrator systems intended of solar energy utilization. The design of the 2D-CONE concentrators had a permissible incident half-angle set to $\pm$ 30° under a conception of giving preference to permeability. Optical characteristics of the 2D-CONE were investigated by using the ray tracing method. As a result, it was confirmed that rays within the permissible incident angle region can condense lights as has been designed. Assuming a flat-plate type solar cell module, a 2D-CONE, and a compound parabolic concentrator (CPC), comparison was made on the amounts of direct insolation that each module can obtain in a year, by using HASP data. As a result, the optical concentration ratio in the 2D-CONE was 1.478 at maximum, and the number of maximum reflection was four. Area used by solar cell modules may be reduced by about 50% in the CPC, but even 2D-CONE with simpler construction and less optical error can be expected of reduction of about 40%. 2 refs., 5 figs.

21248 (CONF-931269–, pp. 37-40) **Optimum design for non-imaging solar concentration with reference to scattering isolation fraction.** Suzuki, A. (Tokyo University of Agriculture and Technology, Tokyo (Japan). Faculty of Technology). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan*

Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993). Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Design and discussion were given on a fixed type compound parabolic concentrator (CPC) having concentration ability and being of a non-imaging optic system, with an intention of utilizing the solar energy. Assuming a 2D-CPC ideal as an optical system, scattering component ratio in full insolation, and optimum angle of acceptance when atmospheric permeability is used fixedly as a parameter were derived theoretically. As a result of calculation, it was found that the optical concentration ratio of the CPC against scattering insolation is always one, and the permissible incident half-angle of CPC depends on distribution of directly arriving light regardless of the scattering light distribution. It was indicated that the atmospheric permeability does not affect much the optical efficiency and can be handled as a constant value as a result of calculating it when it is 0.5 and 1.0. It was made clear that, while the optical efficiency of the CPC rises with increasing permissible incident half-angle, one at which the optical concentration is maximized exists because the geometrical concentration ratio decreases. The result of a calculation revealed that an optimum permissible incident half-angle is 26°. 2 refs., 7 figs.

21249 (CONF-931269–, pp. 113-116) **Performance evaluation of a natural circulating solar collector by experimental measurement in cold regions.** Kanayama, K. (Kitami Institute of Technology, Hokkaido (Japan)); Baba, H.; Endo, N.; Zhao, C.; Higashi, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

With an objective to develop a solar energy water heater designed for cold region use incorporating an antifreezing structure, this paper investigates heat collecting and insulating performance of the existing device. The device investigated is a natural convective device consisting of a feed water tank, a ball valve, a hot water storage tank, and heat collecting panels. According to the result of discussing heat insulating performance of the hot water storage tank, the initial temperature of the tank of 30°C to 80°C has dropped overnight by about 7°C to 12°C when ambient temperature was -30°C. On the other hand, it was found that the heat collecting panels have their temperature drop quickly as soon as insolation is over, and require water in them to be drained to prevent freezing when the ambient temperature is below zero. The following matters were also indicated: air temperature in the panels during heat collection rises so high that convective heat loss increases, and therefore, the convection must be suppressed by means of inserting honeycombs between the glass and the heat collecting plates; and an advantageous system to reduce heat loss due to difference between the tank temperature and the ambient temperature is to drain hot water in the tank about noon and store it separately, and then feed water again to subject it to heat collection. 3 refs., 3 figs., 2 tabs.

21250 (DOE/FTR–94009528) **Travel to Germany for a cooperative agreement on the development of commercialization of US solar thermal energy products and services: Foreign trip report, March 10–19, 1994.** Klimas, P.C.; Tyner, C.E. Sandia National Labs., Albuquerque, NM (United States). 25 Mar 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94009528. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Paul Klimas, Craig Tyner, and Gary Burch (DOE/EE-132) attended the 46th Executive Committee Meeting of the IEA/SolarPACES program in Cologne, Germany, on March 15–17. Meetings included the EC meeting, a coordination meeting moderated by Paul Klimas to resolve differences between SOLEL (LUZ's successor in Israel) and CIEMAT (Spain) regarding development of certain aspects of direct stream generation systems for trough applications, and a planning session for the 7th International Symposium on Solar Thermal Concentrating Technologies to be sponsored by IEA/SolarPACES in Moscow in late September.

21251 (DTH-LV–94-01) **Test of the summer house package from Aidt Miljoe.** Oestergaard Jensen, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Jan 1994. 24p. Contract ENS-51181-93.0062. Order Number DE94771144. Source: OSTI; NTIS.

The report describes tests carried out on the "Summer House Package", produced by the Danish solar collector manufacturer Aidt Miljoe, in order to determine the efficiency of the package. The Summer House Package consists of a small 1.28 m^2 (transparent area) air solar collector with a small fan driven by a 0.28 m^2 (transparent area) solar cell panel. The package is described in detail. The purpose of the package is to keep a summer house dry during the winter by ensuring that it is mainly ventilated during hours with sunshine when air can be heated and dried in the air solar collector. Tests were carried out in order to determine the efficiency of the air solar collector dependent on the air flow through it and for the determination of the efficiency of the solar cell panel + fan dependent on the solar radiation on the solar cell panel. This efficiency consists of: The efficiency of the air solar collector dependent on the air flow through the collector, the air flow rate through the collector dependent on the solar radiation on the solar cell panel and, the influence of the incidence angle of the solar radiation on the air solar collector and the solar cell panel, were determined. These elements may be used when calculating the drying effect of the Summer House Package in a house under real weather conditions. For this purpose a simulation program is required. The efficiency of the air solar collector dependent on the air flow may also be utilized separately for calculating the energy saving potential if the air solar collector is installed as preheater in a ventilation system. (AB)

21252 (DTH-LV-MEDD–259) **Double sided solar collector based on monolithic silica aerogel: Assessment of full scale prototype.** Tursoe-Finnich, K. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Feb 1994. 47p. (In Danish). Contract ENs-1213/89-2. Order Number DE94771124. Source: OSTI; NTIS.

EFP-89.

This project concerns design of a solar collector showing good efficiency and annual yield. During the project a double sided plane symmetrical solar collector was constructed. In the centre was placed a SunStrip-absorber, wrapped in tiles of monolithic silica aerogel, covered with glass on the surfaces and framed in stainless steel with a butyl sealant. All was evacuated to 1 mbar to avoid heat loss in the aerogel. The solar collector was tested for airtightness, pressure drop, as well as efficiency in the solar simulator (only irradiation on the front side) and outdoor efficiency (irradiation on both sides, efficiency related to the irradiation on the front side) but no stagnation test because of fatigue fracture of the absorber. Calculations of yearly yield on the basis of the measured efficiencies were carried out with the EURSOL program. Results show approx. 25% higher yield in a standard domestic hot water system (10 deg. C/50 deg. C) and approx. 100% higher yield when heating the return water in a district heating system (60 deg. C/80 deg. C) for the double sided solar collector compared to an ordinary solar collector for DHW-purposes. In both systems the yield of an ordinary solar collector for high temperature purposes e.g. district heating (with a 2-layer cover of glass and teflon foil) were exactly in between the two collectors yields. The double sided solar collector did not pass an approved reliability test, but showed a satisfactory durability concerning airtightness, raintightness and mechanical strength during the efficiency tests. However, just before the (outdoor) stagnation test took place the absorber had undergone a fatigue fracture due to thermal expansion and contraction caused by the external air pressure combined with high internal friction between the aerogel and the absorber surface. Generally the absorber showed unsatisfactory reliability and durability. (EG) (10 refs.)

1420 Heat Storage

Refer also to citation(s) 21200, 21228, 21229, 21248

21253 (CONF-931269–, pp. 117-120) **Characteristics of a greenhouse with underground heat exchange system and reflecting wall.** Yoshioka, T. (Kumano Technical College, Mie (Japan)); Taga, M.; Ochi, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Effect of making the north side wall of a greenhouse reflective was sought experimentally to improve heat storage efficiency in the greenhouse. The greenhouse has an effective ground area of 30.8 m^2, and the area of reflective north side wall made of a vinyl chloride sheet attached with aluminum foil of 32.3 m^2. Incident energy out of the total heat amount received on the ground surface was calculated to be 25.7%. The experiment has been carried out during the period from December 10, 1992 to March 3, 1993 under a condition of a circulation fan operated around the clock and the greenhouse having no cultivated plants in it. As a result, the average heat storage efficiency in January was 12.69% in the greenhouse with a reflective wall, and 7.27% in a greenhouse without a reflective wall. The values for February were 15.2% and 12.2%, respectively, thereby the effect of the reflective wall was verified. Larger effect of the reflective wall in January was assumed because the reflective wall was installed vertically, so that the effect of the sun's altitude being lower in January was more prominent. 5 refs., 11 figs., 1 tab.

21254 (CONF-931269–, pp. 121-124) **Study on the optimal control of the ground thermal storage system in the greenhouse.** Zheng, M. (Nagoya University, Nagoya (Japan). Faculty of Engineering); Nakahara, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Theoretical analysis was given on an optimal operation control of the ground thermal storage system to store solar energy for the purpose of saving energy in the system operation and providing a temperature environment optimal for growth of plants. A mathematical model for the ground thermal storage greenhouse was prepared on a greenhouse having no cultivated plants in it to verify its applicability. The restrictive condition is the minimum greenhouse temperature for plants to grow normally. Three kinds of performance functions were discussed: one that is intended for a maximum energy conservation, another one that provides a temperature environment optimal for plants to grow in the greenhouse, and still another one that accounts for both of energy and environment. According to an example calculation for ground thermal storage greenhouse having 20 ducts, the operation schedule optimal for energy conservation was found to operate the fan for eight hours from 22:00 PM to 6:00 AM when the lower limit for the room temperature is 7°C as the restrictive condition. An optimal fan operation control was also decided on for a case when the weight ratio of a temperature environment optimal for tomato growth to energy conservation is assumed 10:1. Successive trial calculations have been verified the reasonability of the decision. 6 refs., 4 figs., 2 tabs.

21255 (CONF-931269–, pp. 125-128) **Annual cycle solar energy utilization with seasonal storage. Part 1.: Simple design method of seasonal storage system.** Tanaka, H. (Chubu University, Aichi (Japan)); Okumiya, M.; Sasaki, I.; Nakahara, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

A proposal and an accuracy discussion have been given on a simple design method for an annual solar energy utilization system using a ground embedded water heat storage tank in a model house intended more effective utilization of solar energy by using a seasonal heat storage system. Ground temperature distribution around a long-term heat storage tank was analyzed by solving a three-dimensional heat conduction equation. Calculations were made on the cases of heat storage tank capacities of 120 m^3 and 40 m^3, utilized temperature differences of 35°C and 15°C, and heat insulating material thicknesses of 0 mm and 200 mm. The patterns of charging heat into a long-term heat storage tank were given by approximating them by using SIN curves, and the heat dissipation was calculated every hour. In comparing the heat amount balance in the long-term heat storage tank based on the simple design and the detailed simulation, some deviation was noticed in the heat storage patterns. However, they have agreed nearly well with respect to the annual maximum heat storage amount. Although the deviation in the heat balance patterns may cause difference in controllability such as heat pump and heat collection efficiencies, the difference was regarded not to cause a large impediment in deciding the heat storage tank capacity. 1 ref., 13 figs.

21256 (CONF-931269–, pp. 129-132) **Annual cycle solar energy utilization with seasonal storage. Part 2.: Effect of the seasonal storage on the system performance of the solar system.** Sasaki, I. (Nagoya University, Nagoya (Japan)); Nakahara, N.; Tanaka, H.; Okumiya, M. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Performance of an annual cycle system utilizing seasonal heat storage was discussed by using a simulation on a model house that utilizes solar energy. The solar energy system consists of a solar heat collector and solar cells installed on the roof, a short-term heat storage tank and a hot water storage tank on the ground, and a long-term water heat storage tank under the ground directly below the building. Power consumed in the house is taken care of by the solar cells and the utility power supply, with feedback of excess power taken into account. A simulation has been performed for two years under conditions that the building air conditioning system is operated from 6 o'clock to 12 o'clock, the room heating temperature is set to 18°C and the room cooling temperature to 26°C. Air conditioning load balance, difference in temperatures utilized in the ground heat storage tank, and effect of heat insulating materials according to their thickness were discussed in the simulation. As a result, good room heating and cooling load balance was thought to be 1:1/2 as the effect of load alleviation due to the function of the long-term heat storage tank. Suitable difference in the utilized temperatures was found to be from 35°C to 10°C, which is nearly the same as the annual ground temperature variation. It was confirmed that the heat storage tanks require heat insulation. 4 figs., 6 tabs.

21257 (CONF-931269–, pp. 137-140) **Studies on the performance of heat storage in soil.: Heat transfer analysis in vicinity of a pipe.** Morita, H. (Kinki University, Osaka (Japan)); Fujimoto, K.; Taga, M.; Imai, I. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan*

Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993). Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports experimental studies on heat storage and recovery characteristics in storage of solar energy in the form of heat in soil. The experimental device is a sand box of 56 cm x 56 cm x 80 cm with its circumference heat-insulated, having a copper pipe with an inner diameter of 5 cm embedded in its center as a heat exchange pipe to circulate hot air. The experiment performed heat storage for 50 hours using the hot air temperature and the saturation of water content in the soil as parameters, with the initial soil temperature set to 20°C. Then, the heat was recovered for 50 hours by flowing cool air at 20°C, and temperatures and water contents were measured at different parts. As a result, it was found that soil containing more water had its heat conductivity increased resulting in more heat stored and more heat recovered than in dry soil. The result of numerical calculations using a finite element method indicated that raising the flow velocity of blown air and increasing the heat transmission coefficient would not cause much of increase in the stored heat amount and that decreasing the pitch between the pipes would not change the stored heat amount noticeably, but will increase the recovered heat amount. 1 ref., 10 figs., 2 tabs.

21258 (CONF-931269–, pp. 141-144) **Experiment study on thermal storage tank with capsuled-type thermal storage phse change material.: Basic thermal performance for thermal storage tank and thermal storage phase change material.** Shirota, S. (Nishimatsu, Construction Co. Ltd., Tokyo (Japan)); Yoshida, N. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

An experimental study has been given on characteristics of a heat storage tank filled with a latent heat storing material for the purpose of storing and utilizing solar heat. The experimental device is a stainless steel cylinder with a diameter of 60 cm and a height of 90 cm, with positions of the water inlet changeable from an upper portion to a lower portion, and vice versa, by operating a valve. The latent heat storing material is calcium chloride filled into a spherical capsule with a diameter of about 6.7 cm. In the experiment, a hypothetical heat load was made using hot water or cold water in a preliminary tank, which is sent to a heat storage tank kept at a constant temperature, and temperatures and flow rates were measured at different portions. As a result of the experiment, temperature profiles in the heat storage tank have caused temperature stratification to appear if the temperature is raised using the upper water inlet, or the temperature is reduced using the lower water inlet. If the latent heat storing material accompanies phase change, changing the temperature of the entire heat storage tank by 30°C requires a calorific power of about 10940 Kcal, where the heat amount stored as a latent heat is calculated to be about 43% of the total heat. 1 ref., 13 figs., 2 tabs.

21259 (CONF-931269–, pp. 229-232) **Performance of improved floating-collector-type solar pond.** Inoue, M. (Kinki University, Osaka (Japan). Faculty of Science and Technology); Taga, M.; Matsuoka, Y. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The present report describes the results of an outdoor experiment of an improved floating-collector-type solar pond. In the proposed system, a black collector-board has been submerged in the upper water layer of pond with depth of 10 cm instead of using a sprinkler; a water circulation pipe bank is installed in it; the upper water surface prevents the evaporation loss as transparent film, while pond water is circulated to collect heat. Cold water exchange in the outdoors was also examined. In the indoor experiment, the model ponds simulating various kinds of conventional non-salt type solar ponds were examined using a solar simulator composed of 24 sunlight lamps. Various performances were compared between pellet-type and the present floating-collector-type. Although the former is low in heat loss coefficient, the latter is high in heat collection efficiency. The similar results were obtained in both the indoor and outdoor experiments. The heat storage efficiency is the same in average in these types and probably so is the equilibrium temperature. The floating-collector type solar pond can provide higher temperature water with shorter period of time. The calculation value in the outdoors agrees well with the observed one. 2 refs., 16 figs.

21260 (DTH-LV–94-04) **Heat storage with mixing: Testing and calculations of a Batecs heat storage tank.** Furbo, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Feb 1994. 25p. (In Danish). Contract ENS-51181-92.0052. Order Number DE94771143. Source: OSTI; NTIS.

A Batec commercial hot water tank with an internal heat-exchange coil has been tested. Solar heat is transferred to the tank through the heat exchanger located in the bottom of the tank. The tests proved that there was mixing between solar-heated water and the higher placed water layer, heated by an additional energy source. Due to mixing the temperature in the upper part of the tank is falling and the effect of this system is reduced by roughly 4%. Reduction of the effect depends first of all on the shape of the heat-exchanging coil. The higher the exchange coil stretches in the water-tank, the greater are the chances of mixing and the smaller is the effect. (EG)

15 GEOTHERMAL ENERGY

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 21260, 21267

1503 Geothermal Exploration and Exploration Technology

21261 (LBL–34314) **Coupling of reservoir simulator and a wellbore simulator for geothermal applications.** Hadgu, T.; Zimmerman, R.W.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (United States). May 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-931042–8: Annual meeting of the Geothermal Resources Council (GRC), San Francisco, CA (United States), 10-13 Oct 1993). Order Number DE94011797. Source: OSTI; NTIS; GPO Dep.

Coupling of the reservoir simulator TOUGH and wellbore simulator WFSA is presented. A brief description of the structure of the two computer codes is given. TOUGH was developed at Lawrence Berkeley Laboratory by Pruess. WFSA was developed at Auckland University, New Zealand by Hadgu and Freeston. A new module COUPLE has been written to serve as an interface between TOUGH and WFSA. Two sample problems, involving single-phase flow, two-phase flow, and multiple feedzones, are solved using the coupled simulators. This new procedure should allow more accurate simulations of geothermal reservoir behavior under exploitation.

21262 (LBL–35192) **Large-scale three-dimensional geothermal reservoir simulation on PCs.** Antunez, E.; Moridis, G.; Pruess, K. Lawrence Berkeley Lab., CA (United States). Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940120–2: 19. workshop on

geothermal reservoir engineering, Stanford, CA (United States), 18-20 Jan 1994). Order Number DE94011374. Source: OSTI; NTIS; GPO Dep.

TOUGH2, Lawrence Berkeley Laboratory's general purpose simulator for mass and heat flow and transport was enhanced with the addition of a set of preconditioned conjugate gradient solvers and ported to a PC. The code was applied to a number of large 3-D geothermal reservoir problems with up to 10,000 grid blocks. Four test problems were investigated. The first two involved a single-phase liquid system, and a two-phase system with regular Cartesian grids. The last two involved a two-phase field problem with irregular gridding with production from and injection into a single porosity reservoir, and a fractured reservoir. The code modifications to TOUGH2 and its setup in the PC environment are described. Algorithms suitable for solving large matrices that are generally non-symmetric and non-positive definite are reviewed. Computational work per time step and CPU time requirements are reported as function of problem size. The excessive execution time and storage requirements of the direct solver in TOUGH2 limits the size of manageable 3-D reservoir problems to a few hundred grid blocks. The conjugate gradient solvers significantly reduced the execution time and storage requirements making possible the execution of considerably larger problems (10,000 + grid blocks). It is concluded that the current PCs provide an economical platform for running large-scale geothermal field simulations that just a few years ago could only be executed on mainframe computers.

21263 (SIEMENS-KWU-FGEF–93/002) **Energy project hot dry rock. HDR-technology analysis and development of the HDR-concept: Final report.** Blanck, D.; Heinschild, H.J. Siemens AG Unternehmensbereich KWU, Erlangen (Germany). Bereich Energieerzeugung; Ingenieur-Geologisches Inst., Westheim (Germany). May 1993. 107p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 0326598. Order Number DE94773887. Source: OSTI; NTIS (US Sales Only).

The major part of geothermal energy is stored in the hot, dry underground (Hot Dry Rock, HDR). To use this heat, an artificial heat exchanger has to be created. Water is circulated through this underground loop to extract heat from the rock and to transport it to the surface. Projects carried out in different countries prove that this technology can be realised. Rockmechanic and hydraulic characteristics are best known by in-situ experiments. HDR technology has entered a stage in progress that a pilot-plant can be planned and erected. Producing heat and electricity in a large scale project the same generating costs can be reached as they are known from those regenerative plants as e.g. photovoltaics. (orig.). 12 tabs., 11 figs.

1506 Environmental Aspects

21264 (DOE/OR/22109–T1) **Results of preliminary reconnaissance trip to determine the presence of wetlands in wet forest habitats on the Island of Hawaii as part of the Hawaii Geothermal Project, October 1993.** Wakeley, J.S.; Sprecher, S.W.; Lichvar, R. Army Engineer Waterways Experiment Station, Vicksburg, MS (United States). 25 Feb 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-93OR22109. Order Number DE94013171. Source: OSTI; NTIS; GPO Dep.

In October 1993, the authors sampled soils, vegetation, and hydrology at eight sites representing a range of substrates, elevations, soil types, and plant community types within rainforest habitats on the Island of Hawaii. Their purpose was to determine whether any of these habitats were wetlands according to the 1987 Corps of Engineers Wetlands Delineation Manual. None of the rainforest habitats they sampled was wetland in its entirety. However, communities established on pahoehoe lava flows contained scattered wetlands in depressions and folds in the lava, where water could accumulate. Therefore, large construction projects, such as that associated with proposed geothermal energy development in the area, have the potential to impact a significant number and/or area of wetlands. To estimate those impacts more accurately, they present a supplementary scope of work and cost estimate for additional sampling in the proposed geothermal project area.

1509 Geothermal Engineering

Refer also to citation(s) 21261

21265 (CONF-940120–1) **Liquid-vapor partitioning of NaCl(aq) from concentrated brines at temperatures to 350°C.** Simonson, J.M.; Palmer, D.A.; Carter, R.W. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 19. workshop on geothermal reservoir engineering; Stanford, CA (United States); 18-20 Jan 1994. Order Number DE94007228. Source: OSTI; NTIS; GPO Dep.

Compositions of coexisting liquid and vapor phases have been determined at temperatures from 250 to 350°C for brines containing NaCl and either HCl or NaOH by direct sampling of both phases from a static phase-equilibration apparatus. Thermodynamic partitioning constants for NaCl have been determined from the observed compositions of the coexisting phases combined with the known activity coefficients of NaCl(aq) in the liquid phase. An apparent dependence of the values of these partitioning constants on brine concentration is explained by considering the effect of decreasing pressure on the density of the vapor phase. Concentrations of HCl and NaCl in steam produced from various natural brines may be calculated as functions of temperature and brine composition based on these new results coupled with our previous determinations of the partitioning constants for HCl(aq). Application of these results to The Geysers will be discussed in terms of the composition of postulated brines which could be in equilibrium with observed steam compositions at various temperatures.

21266 (LBL–35263) **Theoretical studies of flowrates from slimholes and production-size geothermal wells.** Hadgu, T.; Zimmerman, R.W.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (United States). Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940120–3: 19. workshop on geothermal reservoir engineering, Stanford, CA (United States), 18-20 Jan 1994). Order Number DE94011364. Source: OSTI; NTIS; GPO Dep.

The relationship between production rates of large diameter geothermal production wells, and slimholes, is studied. The analysis is based on wells completed in liquid-dominated geothermal fields, where flashing occurs either in the wellbore or at the surface. Effects of drawdown in the reservoir, and pressure drop in the wellbore, are included; heat losses from the wellbore to the formation are not presently included in our analysis. The study concentrates on the influence of well diameter on production rate. For situations where the pressure drop is dominated by the reservoir, it is found that the mass flowrate varies with diameter according to $W \sim D^{\alpha}$, where the exponent α is a function of reservoir outer radius, well diameter and skin factor. Similarly, when pressure drop in the wellbore is dominant, the scaling exponent was found to be a function of well diameter and pipe roughness factor. Although these scaling laws were derived for single-phase flow, numerical simulations showed them to be reasonably accurate even for cases where flashing occurs in the wellbore.

21267 (LBL–35500) **Geysers injection modeling.** Pruess, K. Lawrence Berkeley Lab., CA (United States). Apr 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9404102–3: 12. geothermal program review: geothermal's role in global climate change - impacts on the Climate Change Action Plan, San Francisco, CA (United States), 25-28 Apr 1994). Order Number DE94013100. Source: OSTI; NTIS; GPO Dep.

Our research is concerned with mathematical modeling techniques for engineering design and optimization of water injection in vapor-dominated systems. The emphasis in the project has been on the understanding of physical processes and mechanisms during injection, applications to field problems, and on transfer of numerical simulation capabilities to the geothermal community. This overview summarizes recent work on modeling injection interference in the Southeast Geysers, and on improving the description of two-phase flow processes in heterogeneous media.

1520 Geothermal Data and Theory

Refer also to citation(s) 21262, 21264

21268 (LBL–35059) **Liquid-phase dispersion during injection into vapor-dominated reservoirs.** Pruess, K. Lawrence Berkeley Lab., CA (United States). Jan 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940120–4: 19. workshop on geothermal reservoir engineering, Stanford, CA (United States), 18-20 Jan 1994). Order Number DE94011355. Source: OSTI; NTIS; GPO Dep.

The behavior of water injection plumes in vapor-dominated reservoirs is examined. Stressing the similarity to water infiltration in heterogeneous soils, we suggest that ever-present heterogeneities in individual fractures and fracture networks will cause a lateral broadening of descending injection plumes. The process of lateral spreading of liquid phase is viewed in analogy to transverse dispersion in miscible displacement. To account for the postulated "phase dispersion" the conventional two-phase immiscible flow theory is extended by adding a Fickian-type dispersive term. The validity of the proposed phase dispersion model is explored by means of simulations with detailed resolution of small-scale heterogeneity. We also present an illustrative application to injection into a depleted vapor zone. It is concluded that phase dispersion effects will broaden descending injection plumes, with important consequences for pressure support and potential water breakthrough at neighboring production wells.

16 TIDAL AND WAVE POWER

Refer also to citation(s) 21138

1604 Economic, Industrial, and Business Aspects

21269 (SAND–93-3946) **An assessment of research and development leadership in ocean energy technologies.** Bruch, V.L. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012583. Source: OSTI; NTIS; INIS; GPO Dep.

Japan is clearly the leader in ocean energy technologies. The United Kingdom also has had many ocean energy research projects, but unlike Japan, most of the British projects have not progressed from the feasibility study stage to the demonstration stage. Federally funded ocean energy research in the US was stopped because it was perceived the technologies could not compete with conventional sources of fuel. Despite the probable small market for ocean energy technologies, the short sighted viewpoint of the US government regarding funding of these technologies may be harmful to US economic competitiveness. The technologies may have important uses in other applications, such as offshore construction and oil and gas drilling. Discontinuing the research and development of these technologies may cause the US to lose knowledge and miss market opportunities. If the US wishes to maintain its knowledge base and a market presence for ocean energy technologies, it may wish to consider entering into a cooperative agreement with Japan and/or the United Kingdom. Cooperative agreements are beneficial not only for technology transfer but also for cost-sharing.

1607 Tidal Power Plants

Refer also to citation(s) 21200

1608 Wave Energy Converters

21270 (CONF-931269–, pp. 261-264) **Fundamental characteristics of floating wave power device 'Mighty Whale'.** Washio, Y. (Japan Marine Science and Technology Center, Kanagawa (Japan)); Miyazaki, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports the following matters on the fundamental characteristics of a floating wave power device 'Mighty Whale': in a two-dimensional fundamental model experiment for this model, conversion efficiency from wave energy into air energy has reached the maximum value of 58% when the ratio of wave length (λ) to the device length (L) is 1.2; and the height ratio of the permeating wave becomes lower than 0.5, a determination criterion for a wave absorbing breakwater, when $\lambda/L < 2$. Discussions are being given on a prototype model of this device for experiments on the sea. Models of 1/62.5 and 1/30 scales were fabricated according to the basic design of the device to perform water tank experiments. As a result, it was indicated that the maximum value of wave energy absorbing the efficiency in unidirectional irregular waves is 38% of $\lambda/L = 1.3$; and it is when $\lambda/L < 1$ that the height ratio of the permeating wave becomes lower than 0.5 because of effect from diffraction waves in a three-dimensional condition. 8 refs., 10 figs., 1 tab.

21271 (CONF-931269–, pp. 265-268) **Study on the ball screw-type wave power generator system using a caisson and a floating body.** Kimura, M. (Meiji University, Tokyo (Japan)); Omata, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports the following matters on a ball screw-type wave power generator system using a caisson and a floating body: The system works in such a way that it converts vertical motions of the floating body generated by superposed waves in the caisson into reciprocating rotating motion in a screw shaft via ball nuts, and further causes two flywheels to rotate in opposite directions with each other via clutches to rotate two generators. Equations of motion for the flywheels in this system were established and applied to numerical analyses of output characteristics in a hypothetical 40 kW power plant. The equations provided a result that the wave power conversion factor is about 37% when the system is subjected to sinusoidal waves with a wave height of 1.7 m and a cycle of 6.2 seconds. A water tank experiment using a small-scale prototype model verified that the measurement results of waves showed a like trend in the calculation results, and the generator output values calculated by using the measured wave forms are close to the experimental values. 6 refs., 7 figs., 3 tabs.

17 WIND ENERGY

21272 (DOE/FTR–94009529) **Meeting of the IEA Annex XI, in Milan, Italy on lightning protection of wind turbine generator systems and EMC problems in the associated control system: Foreign trip report, March 5–15, 1994.** Muljadi, E. National Renewable Energy Lab., Golden, CO (United States). 17 Mar 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94009529. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The meeting was held in Milan, Catania, and Rome, Italy. There were 21 participants from 8 different countries to discuss wind energy technology and applications.

1701 Resources and Availability (Climatology)

Refer also to citation(s) 21279

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 21282

21273 (CONF-931269–, pp. 3-1-3-6) **Toward the age of commercializing the wind power generation.** Ushiyama, I. (Ashikaga Institute of Technology, Tochigi (Japan)). Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9 and 10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The paper introduces the present status of the wind power generation in Japan and the world. Construction of power generation facilities using concentrated location type wind turbine arrays called 'Wind Farms' has started in the world in the 1980s. Three big Wind Farms in California, the U.S. have 70% of the world's all wind power generated output. About 18000 wind turbines (1.9 million kW), which correspond to a little over 2% of California's generated output, are now running there. Following the U.S., Denmark has 14% of the world wind power generated output, supplying 3% of their domestic power demand by about 3000 wind turbines. Japan started the development under the Sunshine Project in 1978 and has been proceeding with the development of a 500 kW wind turbine with 3 blades and 38m diameter since 1991. The 200 kW one of medium size is fabricated by a private company and approximately 900 turbines have already been exported. A study on the wind characteristics map in Japan indicates that 20% of all 1992 generated output can be supplied by wind power. 7 refs., 6 figs., 2 tabs.

21274 (CONF-931269–, pp. 253-256) **Study of small wind turbine generation system for extreme weather conditions.** Seki, K. (Tokai University, Tokyo (Japan)); Shimizu, Y.; Yasuda, M.; Takanaga, T.; Nakayama, H.; Masuda, T.; Otani, I. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports a study on the small wind turbine generation system (WTGS) assuming weather observing robots to be installed on mountainous regions in the central Asia. The rotor for the WTGS has a diameter of 1.05 m, fixed yaw and pitch, a maximum output of 500 W at a wind velocity of 30 m/s. It is designed to withstand rotations at a wind velocity of 90 m/s. An indoor cold temperature experiment for a WTGS fabricated for a verification experiment showed no problems in actuating rotation in the rotor and the generator, operation of the controls, and heat insulating effect of the battery heat insulating layers in cold environments with temperature ranging from -20°C to -60°C. The WTGS was made to a structure combined with solar cells to achieve stability in the output as a power supply system. A verification model of this system has been installed on a high mountain in Japan for a weatherability experiment (during the 1993-1994 winter season). The system has been operating satisfactorily to date. 3 refs., 7 figs., 1 tab.

21275 (INIS-mf–14221) **Guideline for the erection of wind power plants: Guideline within the framework of the OPET network.** Behnke, R.; Kampet, T. Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Brandenburg, Potsdam (Germany). 1990. 35p. (In German). Order Number DE94774215. Source: OSTI; NTIS (US Sales Only); INIS.

This guideline for the erection of a proper wind power plant is to give hints on some important stations on the way from the idea up to perfect operation of the plant. This guideline, however, does not substitute the professional knowledge of a consulting company or firm neutral to manufacturing. Such firms are listed in an attached list of addresses at the end. When establishing this guideline possible problems which occur in the utilization of wind energy have been considered. These items which in some cases seem to be very problematic should not prevent anybody to trust in the application of wind energy wherever it is economically justified or ecologically useful. (orig./BWI)

21276 (NEI-DK–1517) **Account of the technical-economical development related to windmills: Status at the beginning of 1993.** Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. [1993]. 12p. (In Danish). Order Number DE94771113. Source: OSTI; NTIS; INIS.

The account of the last ten years of technical and economical development related to windmills was produced at Risoe National Laboratory for the Danish Energy Agency (Energistyrelsen) ranging under the Danish government. A comparison is also made between the expected and the actual developments within this field and the amount of energy used during the production of windmills is calculated, including the amount of time it takes to "repay" the energy used during production. It is stated that since 1980 the number of marketed windmills has become ten times higher, and 3% of the electric power now produced in Denmark is provided by windmills, whereas the amount produced by them in 1980 was only 0.05% of total production. Tables illustrate the technological development with regard to size of wind turbines, maximum efficiency, and improvements. Marketed windmills in Denmark are now generally larger, - 150-500 kW in 1993, compared to 11-55 kW in 1980. The 50% increase in capacity is regarded to be the result of better locations according to wind resources, increased efficiency, higher masts, wider rotor-sweep and improved reliability. Lowered production costs are the result of less materials used. Generally speaking, the costs of windmill production have decreased by ca. 40% during the period 1981 - 1992. These facts are explained in more detail and calculation methods and resulting data are described and presented. (AB)

1706 Wind Energy Engineering

Refer also to citation(s) 21200

21277 (CONF-931269–, pp. 257-260) **Experimental studies for the power augmentation system of the vertical-axis wind turbine.** Ushiyama, I. (Ashikaga Institute of Technology, Tochigi (Japan)); Suda, N.; Takano, Y.; Kakita, Y. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Wind tunnel experiments have been carried out to discuss output increasing effect of mounting diffusers and concentrators onto vertical-axis wind turbines of Savonius type and cross flow type. The following findings were obtained as a result: a wind turbine rotor installed at the diffuser inlet in the wind turbines of both models reduced the output lower than that for the wind turbine alone; a wind turbine rotor installed at the diffuser path expanding part increased the output higher than that for the wind turbine alone; installing a concentrator results in output increasing effect; installing both of the concentrator and the diffuser has the appearance of the output increasing effect regardless of installing locations of the wind turbine; however, the maximum power coefficient increases if they are installed in the diffuser path expanding part in the case of the Savonius type wind turbine, and in the diffuser inlet in the case of the cross flow type wind turbine. 3 refs., 8 figs.

21278 (RISO-R–671(EN)) **Measured and simulated turbulence - compared at a section of a rotating wind turbine blade.** Kretz, A.; Aagaard Madsen, H.; Thirstrup Petersen, J. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Mar 1994. 99p. Contract ENS-1364/90-0005; Contract EN3W.0032-DK. Order Number DE94771140. Source: OSTI; NTIS; Also

available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

EFP-90.

The present work investigates the quality of generated synthetic turbulence by comparing it with measured turbulence, represented as the local wind vector at a cross section of a rotating wind turbine blade in natural wind. This procedure has the great advantage that the important spatial structure of the turbulence is tested for through the comparison of the rotationally sampled wind vector. The comparison is extended to cover the normal force on a blade segment, which is derived in a simplified way from the wind vector. In particular, the importance of including the transversal turbulence components is addressed. A recently developed simulation method, which includes all three turbulence components, shows excellent agreement with the measurements and is superior to a model, which includes only the longitudinal component. It is demonstrated that inclusion of all three components is important for the simulation of the local wind vector, represented in the present context as the relative velocity and the angle of attack. The model, which includes only the longitudinal component, gives rise to underestimation of the relative velocity variations and overestimation of the angle of attack variations originating from turbulence. In order to demonstrate the effect of these discrepancies on the resulting force on the blade segment, the force is derived in a simplified way by use of linearized normal force coefficient curve. Generally, high slopes (below stall onset) result in overestimation of the force variation, and low slopes (above stall onset) result in underestimation of the force variation. Rainflow counting and estimation of fatigue damage show that the transversal components in general are of great importance for the prediction of fatigue. (au) (17 tabs., 77 ills., 29 refs.)

21279 (RISO-R–704(EN)) **Flow-response characteristics of the Kaijo Denki omni-directional sonic anemometer (TR-61B).** Mortensen, N.G. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Apr 1994. 32p. Order Number DE94771141. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

This report describes a commercially available, three-dimensional sonic anemometer/thermometer: the Kaijo Denki DAT-300 fitted with an omni-directional sensor, the TR-61B probe head. Based on an analysis of the probe geometry and a comprehensive wind tunnel investigation it is found that the flow around the probe head is significantly distorted. Sonic-derived horizontal wind speed, wind direction and wind vector tilt deviate by as much as 15%, 5 deg. and 3 deg., respectively, from the corresponding quantities in the wind tunnel. The flow distortion reflects strongly the geometry of the probe head and is partly dependent on the flow speed. Expressions are derived to assess the transducer shadow effect, but these alone cannot explain the response characteristics of the sonic. Instead, an ad-hoc calibration procedure is suggested, employing correction tables based on the wind tunnel measurements. The corrected horizontal and vertical wind speed components compare well to the wind tunnel, even though the vertical response shows some scatter. Preliminary field investigations support the correction scheme and suggest that the calibration may be stable over periods of several years. Expressions for calculating the sound-virtual temperature from the transit times, taking into account the translation of the sound wave filed due to the flow speed component perpendicular to the sound path, have been derived. An exact correction term to the sonic temperature output follows directly. (au) (2 tabs., 22 ills., 12 refs.)

21280 (RISO-R–726(EN)) **Meteorology and Wind Energy Department annual progress report 1 January 1993 - 31 December 1993.** Dannemand Andersen, P.; Skrumsager, B. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Apr 1994. 44p. Order Number DE94771139. Source: OSTI; NTIS.

The primary objective of the department is to make an essential contribution to research, development, and consulting in connection with the production, application, and export of Danish wind turbines. A secondary objective is to carry out research in boundary-layer meteorology, which is fundamental to solving major environmental and energy problems of society. There is a general demand for an improved ability to describe and estimate flows and fluxes in the lower atmosphere with regard to wind resources, a multitude of environmental questions, and loads on structures including wind turbines. Through its research and development work, the department is able to develop methodologies including computer models for use by industry, institutions, and governmental authorities. In the long view the department is developing facilities and programmes to enable it to serve as a national and European centre for wind-energy and boundary-layer meteorological research. (au)

21281 (RISO-R–741(EN)) **The Vindeby project: A description.** Barthelmie, R.J.; Courtney, M.S.; Hoejstrup, J.; Sanderhoff, P. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1994. 40p. Contract ENS-1364/91-0006; Contract ENS-51171-91.0008; Contract Order Number DE94771142. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

EFP-91; EFP-92; EFP-93.

The Vindeby monitoring project has been established to provide information on the world's first offshore wind farm at Vindeby, Denmark. The project will consider all aspects of offshore meteorology which are relevant to offshore wind energy production in addition to turbine loading and behaviour in offshore conditions. This report contains a description of the site, including obstacles, roughness and fetch. The instrumentation used on each mast is described. Details of the data acquisition and the structure of the data bases holding the observations are given. Possible distortion of the wind flow at both land and sea masts has also been considered. (au) (11 tabs., 15 ills., 12 refs.)

21282 (SAND–93-4037C) **Navier-Stokes simulations of WECS airfoil flowfields.** Homicz, G.F. (Sandia National Lab., Albuquerque, NM (United States). Computational Fluid Dynamics Dept.). Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940548–3: American Wind Energy Association annual conference and exhibition, Minneapolis, MN (United States), 9-13 May 1994). Order Number DE94013341. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories has initiated an effort to apply Computational Fluid Dynamics (CFD) to the study of WECS aerodynamics. Preliminary calculations are presented for the flow past a SAND 0018/50 airfoil. The flow solver used is F3D, an implicitly, finite-difference code which solves the Thin-Layer Navier-airfoil. The flow solver used is F3D, an implicit, finite-difference code which solves the Thin-Layer Navier-Stokes equations. 2D steady-state calculations are presented at various angles of attack, α. Sectional lift and drag coefficient, as well as surface pressure distributions, are compared with wind tunnel data, and exhibit reasonable agreement at low to moderate angles of attack. At high α, where the airfoil is stalled, a converged solution to the steady-state equations could not be obtained. The flowfield continued to change with successive iterations, which is consistent with the fact that the actual flow is inherently transient, and requires the solution of the full unsteady form of the equations.

21283 (SAND–94-1009) **Sandia wind program FY94 annual operating plan.** Dodd, H.M. Sandia National Labs., Albuquerque, NM (United States). 1 Oct 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013460. Source: OSTI; NTIS; GPO Dep.

This document presents the objectives, accomplishments and activity plan for the Sandia Wind Energy Technology Program. The status of the current program is summarized and the planned FY94 activities are defined. Appendices detailing the cost, performance and schedule associated with these activities are also included. Funding requirements are given for several scenarios in order to reflect the impact of funding variability on program progress.

20 FOSSIL-FUELED POWER PLANTS

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Refer also to citation(s) 20638, 20713, 20718, 20723, 21868, 21886, 21949, 22230, 22475

21284 (AUC-IES-R–90-27) **Adjustment of a model of a power-plant boiler to the experimental data.** Hansen, T.; Andersen, P.; Bjerring, P.; Soerensen, O. Aalborg Universitetscenter (Denmark). Inst. for Elektroniske Systemer. Jun 1990. 123p. (In Danish). Order Number DE94771146. Source: OSTI; NTIS.

A research project based on operation of the boiler system at the Randers Combined Heat-and Power Plant is developed to find new strategies to regulate the thermal conditions of the plant. As a part of this project, a simulator of the boiler section has been created. This simulator is based on a model describing the boiler section both quantitatively and qualitatively 'well enough' to be used to design and test the regulating systems. Models of the components the boiler section consists of, have been presented. These models encompass three general equations for thermal systems: mass balance, energy balance and impulse balance. As there were no data available for the evaporator section of the Randers boiler, the evaporator model was chosen to be adjusted to the experimental data collected in the power plant. The task involved preparation of an appropriate computer programme for data acquisition at Randers Plant, data processing, development of an optimization method, creation of a programme for simulator adjustment to the experimental data, and evaluation of results achieved. (EG) (10 refs.)

21285 (AUC-IES-R–90-35) **Modelling and simulation of a coal-fueled 85 MW drum boiler.** Hansen, T. Aalborg Universitetscenter (Denmark). Inst. for Elektroniske Systemer. Oct 1990. 165p. (In Danish). Order Number DE94771147. Source: OSTI; NTIS.

In a research project, the aim of which is to develop multivariable controllers for fossil fueled power plants, the construction of a real time boiler simulator is an essential part, since such a simulator permits initial tests of controllers in a safe environment. Basic requirements for such a simulator are: Simulation has to be carried out in real time. The model on which the simulation is based must represent the boiler correctly over a wide operating range. The simulator must have an electrical interface which accurately represents instrumentation of the simulated boiler. This report describes the development of a model representing an 85 MW drum boiler unit at Randers Kraftvarmevaerk, Denmark. A strategy for developing the boiler model is presented. The strategy, which is also reflected in the basic structure of the report, involves the following steps: (1) Description of the boiler process. (2) Choice of methodology for modelling the boiler. (3) Development of models for subsystems. (4) Choice of a numerical method for solving model equations. (5) Simulation of submodels and evaluation of model qualities. (au) (21 refs.)

21286 (DOE/FE–0296P) **Coal diesel combined-cycle project: Comprehensive report to Congress: Clean Coal Technology Program.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Office of Clean Coal Technology. May 1994. 23p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012984. Source: OSTI; NTIS; GPO Dep.

One of the projects selected for funding is a project for the design, construction, and operation of a nominal 90 ton-per-day 14-megawatt electrical (MWe), diesel engine-based, combined-cycle demonstration plant using coal-water fuels (CWF). The project, named the Coal Diesel Combined-Cycle Project, is to be located at a power generation facility at Easton Utilities Commission's Plant No. 2 in Easton, Talbot County, Maryland, and will use Cooper-Bessemer diesel engine technology. The integrated system performance to be demonstrated will involve all of the subsystems, including coal-cleaning and slurrying systems; a selective catalytic reduction (SCR) unit, a dry flue gas scrubber, and a baghouse; two modified diesel engines; a heat recovery steam generation system; a steam cycle; and the required balance of plant systems. The base feedstock for the project is bituminous coal from Ohio. The purpose of this Comprehensive Report is to comply with Public Law 102-154, which directs the DOE to prepare a full and comprehensive report to Congress on each project selected for award under the CCT-V Program.

21287 (DOE/MC/23167–3526) **Generic turbine design study: Final report.** Westinghouse Electric Corp., Orlando, FL (United States). Power Generation Business Unit. Jun 1993. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23167. Order Number DE94000051. Source: OSTI; NTIS; GPO Dep.

The purpose of Task 12, Generic Turbine Design Study was to develop a conceptual design of a combustion turbine system that would perform in a pressurized fluidized bed combustor (PFBC) application. A single inlet/outlet casing design that modifies the W251B12 combustion turbine to provide compressed air to the PFBC and accept clean hot air from the PFBC was developed. Performance calculations show that the net power output expected, at an inlet temperature of 59°F, is 20,250 kW.

21288 (DOE/METC/C–94/7131) **Conceptual design and economics of coal and gas co-fired PFBC plants.** Horazak, D.A. (Gilbert/Commonwealth, Inc., Reading, PA (United States)); White, J.S.; Harbaugh, L.; Bonk, D.L.; Reed, M.E. USDOE Morgantown Energy Technology Center, WV (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-940445–6: 56. annual American power conference, Chicago, IL (United States), 25-27 Apr 1994). Order Number DE94012395. Source: OSTI; NTIS; GPO Dep.

Advanced 2nd-Generation pressurized fluidized bed (PFBC) cycles are viewed as having increased technological risk related to the pressurized carbonizer systems regardless of their favorable economics and performance. The 1.5-Generation PFBC cycle combines the performance advantages of the 2nd-Generation PFBC plant with the reduced risk of a natural-gas-fired gas turbine. This paper describes the technical and economic evaluation of 246-MW and 111-MW 1.5-Generation PFBC cycles for utility or industrial power generation. Economic evaluation includes sensitivity studies to determine the effects of operating variables and fuel prices on capital cost and COE. The thermal efficiency, capital cost, and cost of electricity of 1.5-Generation PFBC plants are better than pulverized coal plants, and in between 1st- and 2nd-Generation PFBC plants. Plant capacity turndown is expected to range from full-load (design flows of natural gas and coal) down to 38-percent load (zero natural gas and 50-percent coal flow). The plant can be reduced to 76-percent load by reducing natural gas flow without disturbing the coal feed to the rest of the plant, and other cost-effective variations are also possible. The 1.5-Generation PFBC plant is the logical repowering alternative to 1st-Generation PFBC, and provides a reasonable bridge to later conversion to a 2nd-Generation PFBC, thus advancing the adoption of 2nd-Generation PFBCs in the future.

21289 (DOE/PC/91154–T8) **Development of a high-performance coal-fired power generating system with pyrolysis gas and char-fired high temperature furnace (HITAF): Quarterly progress report 8, October–December 1993.** Foster Wheeler Solar Development Corp., Livingston, NJ (United States). Feb 1994. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91154. Order Number DE94013061. Source: OSTI; NTIS; GPO Dep.

A concept for an advanced coal-fired combined-cycle power generating system is currently being developed. The first phase of this three-phase program consists of conducting the necessary research and development to define the system, evaluating the economic and technical feasibility of the concept, and preparing an R&D plan to develop the concept further. The power generating system being developed in this project will be an improvement over current coal-fired systems. Goals have been specified that relate to the efficiency, emissions, costs, and general operation of the system. The system proposed to meet these goals is a combined-cycle system where air for a gas turbine is indirectly heated to approximately 1800°F in furnaces fired with coal-derived fuels and then directly heated in a natural-gas-fired combustor to about 2400°F. The system is based on a pyrolyzing process that converts the coal into a low-Btu fuel gas and char. The fuel gas is relatively clean, and it is fired to heat tube surfaces that are susceptible to corrosion and problems from ash deposition. In particular, the high-temperature air heater tubes, which will need to be a ceramic material, will be located in a separate furnace or region of a furnace that is exposed to combustion products from the low-Btu fuel gas only.

21290 (DOE/PC/92158–T5) **Design and development for a low emission boiler system.** Riley Stoker Corp., Worcester, MA (United States). [1994]. 169p. Sponsored by USDOE, Washington,

DC (United States). DOE Contract AC22-92PC92158. Order Number DE94013077. Source: OSTI; NTIS; GPO Dep.

design ofrtment of Energy initiated the Combustion 2000 program to develop the next generation of coal-fired power plants. Sargent & Lundy (S&L) is working on the Low Emission Boiler System (LEBS) portion of the program led by Riley Stoker Corporation, with support from Textron Defense Systems, Tecogen, and Reaction Engineering International. Together these organizations form "the Riley Team." There are four phases of the LEBS development program. Currently, we are working in Phase I, which involves the design of a 400 MWe unit. Phase II through IV will involve pilot scale component testing and a Proof-of-Concept facility (~40MWe) design, construction, and operation. This document comprises the Design and Development Report for the LEBS. The report describes the design basis, design uncertainties and development plan for each of the major LEBS subsystems.

21291 (DOE/PC/92159–T5) **Engineering development of advanced coal-fired low-emission boiler systems: Technical progress report No. 5, October–December 1993.** Combustion Engineering, Inc., Windsor, CT (United States). 6 Apr 1994. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92159. Order Number DE94013062. Source: OSTI; NTIS; GPO Dep.

Work continued as planned and scheduled. Total expenditures are below budget. Task 2 is complete. Task 3 is complete except for R, D & T Plan – Phase II. Task 4 is currently slightly behind schedule but is projected to finish on or ahead of schedule. Task 5 was started early. The following major deliverables were issued: (1) Technical Paper for '93 International Joint Power Generation Conference. (2) Technical Paper for IEA Second International Conference, and (3) Topical Report by EAR on Air Toxics. Subtask 4.1 – Engineering Analysis in support of the CGU design is nearly complete and partial design specifications are being employed in Task 5. Subtask 4.2 – Experimental Research efforts consisted of the first series of Drop Tube Furnace tests. Data is being analyzed. Subtask 4.3 – Modeling work to data resulted in input files for Boiler Simulation Facility and flow pattern convergence was attained. Particle combustion is the next step. This work will be reported on at the next Quarterly Project Review meeting. Task 5 was started early to facilitate Task 6 schedule and quality. Integration of the SNO_x Hot Scheme into the boiler and turbine/feedwater train was optimized and design work on the boiler and "backend" is underway. Cost estimating assumptions and methodology were discussed at length and finalized. The RAM analysis is nearly complete. BOP engineering is in progress. No changes to the Work Plan are anticipated for the next quarter.

21292 (NEI-DK–1488) **The use of 'smooth water' in tube condensers of dual-purpose power plants.** Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Fjernvarme og produktion af el og varme, Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Fjernvarme og produktion af el og varme. Hammer, F.; Steiff, A.; Andersen, H. Bruun og Soerensen Energiteknik A/S, Aarhus (Denmark); Thermische Verfahrenstechnik GmbH, Dortmund (Germany); Elsamprojekt A/S, Fredericia (Denmark). Jan 1994. 89p. (In Danish). Contract ENS-1323/90-0011. Order Number DE94771153. Source: OSTI; NTIS.

EFP-90.

The purpose of the project is: To analyze the problems which the application of friction reducing additives entail in heat transmission in the CHP district heating exchangers. To make proposals to improve the heat exchange conditions and estimate their financial consequences. Utilization of additives in district heating water reduces turbulences of the flow so that heat transmission between water and pipe or plate wall in heat exchangers is reduced. A number of demonstration and development projects have been carried out with reference to the utilisation of friction-reducing additives for district heating purposes. The designation for this technology in Denmark became the term "smooth water". When operating with solutions of surfactants in heat exchangers with straight pipes, a reduction of the heat transfer coefficient exceeding 80% is possible. Four different cases formed the basis for the project calculations: The reference calculation includes the known conditions concerning operation with normal district heating water. Smooth water without compensation. In this case it has been pre-assumed that friction reducing additives are added without any kind of compensation in the heat exchangers. Smooth water, using turbulators (spiral spring) in the water tube of the heat exchanger. Smooth water, using more passes in the exchanger. The use of smooth water without compensation was found to entail considerable loss of electric power and unacceptable pressure increases. In a back pressure plant the loss will be "regained" as district heating, while the condenser loss in the bleeder-type plant will heavily increase. Apparently, these problems can be overcome by inserting turbulation creating springs or webs in the district heating tubes. Alterations of pressure and flow conditions in the turbine circuit are moderate. (EG)

21293 (NEI-FI–227) **Co-combustion of mixed plastics with coal in a bubbling fluidized bed incinerator.** Frankenhaeuser, M. (Neste Oy, Porvoo (Finland)); Manninen, H.; Virkki, J.; Vesterinen, R.; Kojo, I.; Ruuskanen, I. Neste Oy, Helsinki (Finland). 1991. 22p. Order Number DE94771080. Source: OSTI; NTIS.

Test results are reported from the co-combustion of mixed household plastics (4 % chlorine) with coal (0,5 % S). The trials were performed in a bubbling fluidized bed low-pressure steam boiler. It is concluded that both inorganic and organic total specific emissions (g/MJ) are lower for mixed household plastics than for coal. A fluidized bed plant equipped with efficient dust and carbon monoxide control can meet the most stringent foreseeable regulations for PCDD/PCDF emissions.

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Refer also to citation(s) 20614, 20625, 20678, 20694, 20695, 20696, 20697, 20698, 21285, 21845, 22499

21294 (ANL/ES/CP–80869) **Experimental evaluation of sorbents for the capture of mercury in flue gases.** Livengood, C.D.; Huang, H.S.; Wu, J.M. Argonne National Lab., IL (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–18: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012649. Source: OSTI; NTIS; GPO Dep.

The results and conclusions to date from the Argonne research program on air toxics (mercury) control can be summarized as follows: (1) Mercury emissions from coal-fired combustors are generally in the range of 10–70 $\mu g/m^3$ and are highly variable. (2) Existing FGC technologies are only partially effective in controlling mercury emissions. (3) Lime hydrates, either regular or high-surface-area, are not effective in removing mercury. (4) Mercury removals are enhanced by the addition of activated carbon. (5) Mercury removals with activated carbon decrease with increasing temperature, larger particle size, and decreasing mercury concentration in the gas. (6) Chemical pretreatment (with sulfur or $CaCl_2$) can greatly increase the removal capacity of activated carbon.

21295 (ANL/ES/CP–82950) **Emerging flue-gas cleanup technologies for combined control of SO_2 and NO_x.** Livengood, C.D. (Argonne National Lab., IL (United States)); Markussen, J.M. Argonne National Lab., IL (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405156–1: 7. NO_x control conference, Oak Brook, IL (United States), 2-3 May 1994). Order Number DE94012465. Source: OSTI; NTIS; GPO Dep.

Enactment of the 1990 Clean Air Act Amendments, as well as passage of legislation at the state level has raised the prospect of more stringent nitrogen oxides (NO_x) emission regulations and has fueled research and development efforts on a number technologies for the combined control of sulfur dioxide (SO_2) and NO_x. The integrated removal of both SO_2 and NO_x in a single system can offer significant advantages over the use of several separate processes, including such factors as reduced system complexity, better operability, and lower costs. This paper reviews the status of a number of integrated flue-gas-cleanup systems that have reached a significant stage of development, focusing on post-combustion processes that have been tested or are ready for testing at the pilot scale or larger. A brief process description, a summary of the development

status and performance achieved to date, pending commercialization issues, and process economics (when available) are given for each technology.

21296 (BNL–60375) **Krakow clean fossil fuels and energy efficiency project.** Pierce, B.L.; Butcher, T.A. Brookhaven National Lab., Upton, NY (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);Agency for International Development, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940780–1: 10. annual coal preparation, utilization and environmental control contractors conference, Pittsburgh, PA (United States), 18-21 Jul 1994). Order Number DE94013022. Source: OSTI; NTIS; GPO Dep.

Almost half of the energy used for beating in Krakow is supplied by low-efficiency boilerhouses and home coal stoves. Within the town, there are more than 1,300 boilerhouses with a total capacity of 1,071 MW, and about 100,000 home furnaces with a total capacity of about 300 MW. More than 600 boilerhouses and 60 percent of the home furnaces are situated near the city center. These facilities are referred to as "low emission sources" because they have low stacks. They are the primary sources of particulates and hydrocarbons in the city, and major contributors of sulfur dioxide and carbon monoxide. The Support for Eastern European Democracy (SEED) Act of 1989 directed the US Department of Energy (DOE) to undertake an equipment assessment project aimed at developing the capability within Poland to manufacture or modify industrial-scale combustion equipment to utilize fossil fuels cleanly. This project is being implemented in Krakow as the "Krakow Clean Fossil Fuels and Energy Efficiency Project." Funding is provided through the US Agency for International Development (AID). The project is being conducted in a manner that can be generalized to all of Poland and to the rest of Eastern Europe.

21297 (DOE/MC/30252–3732) **Management of dry flue gas desulfurization by-products in underground mines: Quarterly technical progress report, [October 1, 1993–December 31, 1993].** Thomasson, E.M.; Chugh, Y.P.; Esling, S.; Honaker, R.; Paul, B.; Sevin, H. Southern Illinois Univ., Carbondale, IL (United States). Jan 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-93MC30252. Order Number DE94004115. Source: OSTI; NTIS; GPO Dep.

The "Management of Dry Flue Gas Desulfurization By-Products in Underground Mines" program is one of the largest programs ever undertaken by the Mining Engineering Department of Southern Illinois university, both in terms of complexity and in terms of funding. Total funding over the expected four-year extent of the program, including both Department of Energy, matching Southern Illinois University funds, and contributed funds, this program exceeds three million dollars. The number of cooperating organizations adds to the management complexity of the program. It was believed, therefore, that sound management plan and management base is essential for the efficient and effective conduct of the program. This first quarter period (i.e., October 1–December 31, 1993) was developed to establishing the management base, developing a sound management plan, developing a test plan, and developing sound fiscal management and control. Actual technical operations, such as residue sample acquisition, residue analyses, groundwater sample acquisition and analyses, and material handling studies will get underway early in the next quarter (i.e., January 1–March 31, 1994). Some early results of residue analyses and groundwater analyses should be available by the end of the second quarter. These results will be reported in the next Technical Progress Report.

21298 (DOE/PC/89653–T13) **ESP performance analysis during the 180 MW demonstration of advanced tangentially-fired combustion techniques for the reduction of nitrogen oxide emissions from coal fired boilers.** Landham, E.C. Jr. (Southern Research Inst., Birmingham, AL (United States)); Faulkner, M.G. Southern Co. Services, Inc., Birmingham, AL (United States); Southern Research Inst., Birmingham, AL (United States). Sep 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89653. (SRI-ENV–93-824-7215-v). Order Number DE94010218. Source: OSTI; NTIS; GPO Dep.

The particle mass loadings exiting the furnace and entering the ESP were within the expected range predicted by the EPRI data base for the ash content of the coal burned. In general, only minor variations in mass loadings were observed between the test phases. At full load, the dry standard mass loadings were within 1 standard deviation of the mean of all tests. For all test phases, the average difference from the baseline mass loading was 6%. This is very little change, and is as likely to be related to coal characteristics or noise in the measurement as to low-NO_x modifications. ESP performance modeling was performed on the assumption that the only differences between the test phases were the gas volume changes caused by the measured differences in long-term oxygen levels. Otherwise, all test phases were assumed to have the same operating conditions as the baseline condition. Projections were made for a series of hypothetical ESPs with SCA values ranging from 150 to 500 ft^2/1000 acfm. Hot-side modeling results showed that LNCFS 2 operation is expected to increase the ESP particle penetration over the baseline values by from 8% for a small ESP to 27% for a large ESP. For LNCFS 3 operation, the increase is from 5 to 19% for small and large ESPs. For LNCFS 1 operation, the ESP particle penetration is reduced from the baseline levels by from 4% for a small ESP to 13% for a large ESP. Because of basic differences in their natures, the projected performance of the cold-side ESPs was significantly better than the hot-side units for all cases. Because of the lower overall emissions, the changes produced by the volume flow increases resulted in higher relative changes. The model predicted penetration increases of 9% to 35% for LNCFS 2 and 7% to 25% for LNCFS 3. The reduced oxygen during LNCFS 1 reduced penetration by 6% to 17%.

21299 (DOE/PC/89653–T14) **180 MW demonstration of advanced tangentially-fired combustion techniques for the reduction of nitrogen oxide (NO_x) emissions from coal-fired boilers: Final report.** Tavoulareas, E.S. (Energy Technologies Enterprises Corp. (United States)); Hardman, R.; Eskinazi, D.; Smith, L. Energy Technologies Enterprises Corp. (United States); Southern Co. Services, Inc., Birmingham, AL (United States). Feb 1994. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89653. Order Number DE94011174. Source: OSTI; NTIS; GPO Dep.

This report provides the key findings of the Innovative Clean Coal Technology (ICCT) demonstration project at Gulf Power's Lansing Smith Unit No. 2 and the implications for other tangentially-fired boilers. L. Smith Unit No. 2 is a 180 MW tangentially-fired boiler burning Eastern Bituminous coal, which was retrofitted with Asea Brown Boveri/Combustion Engineering Services' (ABB/CE) LNCFS I, II, and III technologies. An extensive test program was carried-out with US Department of Energy, Southern Company and Electric Power Research Institute (EPRI) funding. The LNCFS I, II, and III achieved 37 percent, 37 percent, and 45 percent average long-term NO_x emission reduction at full load, respectively (see following table). Similar NO_x reduction was achieved within the control range (100–200 MW). However, below the control point (100 MW), NO_x emissions with the LNCFS technologies increased significantly, reaching pre-retrofit levels at 70 MW. Short-term testing proved that low load NO_x emissions could be reduced further by using lower excess O_2 and burner tilt, but with adversed impacts on unit performance, such as lower steam outlet temperatures and, potentially, higher CO emissions and LOI.

21300 (DOE/PC/91293–10) **Direct catalytic decomposition of nitric oxide: Quarterly technical progress report No. 10, January–March 1994.** Flytzani-Stephanopoulos, M.; Sarofim, A.F.; Zhang, Y.; Sun, T. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering. [1994]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91293. (CONF-940301–34: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994). Order Number DE94012616. Source: OSTI; NTIS; GPO Dep.

This project investigates a suitable catalyst system for the direct nitric oxide decomposition in post-combustion gas streams. This process does not use a reductant, such as the ammonia used in the Selective Catalytic Reduction (SCR) of NO_x to nitrogen. Therefore, it is a greatly simplified process basically involving passing the flue gas through a catalytic converter. Catalysts are prepared by incorporating metal cations into zeolite supports according to ion

exchange procedures widely used in preparation of metal/zeolite catalysts. Particular emphasis is given in this work on promoted Cu-exchanged zeolites, especially the catalyst systems Mg/Cu-ZSM-5 and Ce/Cu-ZSM-5, which are promising for NO conversion to nitrogen at typical flue gas O_2 and NO levels and over the temperature range of 673–873°C. The effect of zeolite modification, copper exchange level and catalyst preparation conditions on the catalytic activity are studied in O_2-free, O_2-rich gases, as well as wet (2–20% H_2O) gas streams in a packed-bed microreactor. Characterization of catalysts is performed by XRD, STEM, TEM and ESR. During this quarter it was found that severe steaming (20% H_2O) of Na-ZSM-5 at temperatures above 600°C caused partial vitreous glass formation and dealumination. Unpromoted Cu-ZSM-5 catalysts suffer drastic loss of NO decomposition activity in wet gas streams at 500°C. Activity is partially recovered in dry gas. Copper migration out of the zeolite channels leading to CuO formation has been identified by STEM/EDX. In Ce/Cu-ZSM-5 catalysts the wet gas activity i's greatly improved. CuO particle formation is less extensive and the dry gas activity is largely recovered upon removal of the water vapor.

21301 (DOE/PC/91306–10) **Sorption and chemical transformation of PAHs on coal fly ash: Technical progress report No. 10, February 1–April 30, 1994.** Mamantov, G.; Wehry, E.L. Tennessee Univ., Knoxville, TN (United States). Dept. of Chemistry. [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91306. Order Number DE94012614. Source: OSTI; NTIS; GPO Dep.

At this time the correlation (if I any) between surface "roughness" of fly ash particles, as inferred from measurements of fractal dimensions, and the photochemical reactivity of sorbed PAHs is unclear. This work will be extended to a second fly ash, the "Texas lignite" studied previously. PAHs associated with most fractions of this ash exhibit much greater photoreactivity than those associated with the KA ash (to which all the data in Table I pertain). PAHs sorbed on the unfractionated Texas lignite ash, and on the mineral and magnetic fractions obtained from it, exhibit phototransformation, but PAHs sorbed on the carbonaceous fraction of this ash exhibit negligible photoreactivity. As discussed in Technical Progress Reports 8 and 9, we are examining the influence of co-adsorbed organic molecules on the phototransformation of PAHs sorbed on coal fly ash. The co-adsorbates of greatest interest are those that are actually detected in sampled airborne particulate matter. For this reason, we have chosen long-chain alkanes and aliphatic carboxylic acids for initial use as co-adsorbates; these species are frequently found as adsorbates in chemical analyses of sampled airborne particulate matter. We wish to examine adsorbates that are more volatile than most PAHs (and thus are likely to deposit on fly ash in the atmosphere after the deposition of PAHs is largely complete) as well as those that are less volatile than PAHs (and thus are likely to be present on fly ash prior to the deposition of PAHs).

21302 (DOE/PC/91338–T7) **High SO_2 removal efficiency testing: Technical progress report.** Blythe, G. Radian Corp., Austin, TX (United States). 28 Apr 1994. 44p. Sponsored by USDOE, Washington, DC (United States);Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC22-92PC91338. Order Number DE94013474. Source: OSTI; NTIS; GPO Dep.

The project involves testing at six full-scale utility flue gas desulfurization (FGD) systems, to evaluate low capital cost upgrades that may allow these systems to achieve up to 98% SO_2 removal efficiency. The upgrades to be evaluated mostly involve using additives in the FGD systems. On the base program, testing was completed at the Tampa Electric Big Bend Station in November 1992. The upgrade option tested was DBA additive. For Option 1, at the Hoosier Energy Merom Station, three upgrade options have been tested: DBA additive, sodium formate additive, and high pH set point operation. Option 2 has involved testing at the Southwestern Electric Power Company Pirkey Station. Both sodium formate and DBA additives were tested as potential upgrade options at Pirkey. On Option 3, for testing at the PSI Energy Gibson Station, a DBA additive performance and consumption test was conducted in late February through mid-March 1994. Preliminary results from these tests are discussed in Section 3 of this progress report. Option 4 is for testing at the Duquesne Light Elrama Station. The FGD system employs magnesium-enhanced lime reagent and venturi absorber modules. An EPRI-funded model evaluation of potential upgrade options for this FGD system, along with a preliminary economic evaluation, determined that the most attractive upgrade options for this site were to increase thiosulfate ion concentrations in the FGD system liquor to lower oxidation percentages and increase liquid-phase sulfite alkalinity, and to increase the venturi absorber pressure drop to improve gas/liquid contacting. Parametric testing of these upgrade options was conducted in late March 1994. Preliminary results from these tests are also discussed in Section 3 of this progress report.

21303 (DOE/PC/92521–T134) **Novel technologies for SO_x/NO_x removal from flue gas: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Kung, H. (Northwestern Univ., Chicago, IL (United States)); Kung, M.; Yang, B.; Spivey, J.J.; Jang, B.W. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012561. Source: OSTI; NTIS; GPO Dep.

The goal of this project is to develop a cost-effective low temperature deNO_x catalyst to be used in the Research Triangle Institute-Waterloo SO_x/NO_x process for boiler retrofit applications. The performance goal of the catalyst is to convert over 80% of the NO in the flue gas at a temperature as low as 150°C in the presence of 4% O_2 and 10% water. Based on the results obtained in the first quarter, which showed that modification of a Cu-ZrO_2 catalyst with Nd increased the conversion of NO to N_2, especially at higher partial pressures of oxygen, and that ethanol was a more effective reductant than propene in the presence of water vapor, research was conducted in this quarter to investigate the use of other modifiers and other alcohols as reductants. It was found that modification of Cu-ZrO_2 by La was more effective than by Nd or Gd. It decreased the hydrocarbon combustion activity of the catalyst while increasing the NO conversion. A Cu-Ga_2O_3 catalyst was also tested. It was superior to Cu-ZrO_2 at temperatures higher than 250°C, but inferior at lower temperatures. On the La-Cu-ZrO_2 catalyst, isobutanol was a very effective reductant for NO, being more effective than ethanol. In the presence of 4% O_2, 2% water, and with a space velocity of 3000 h^{-1}, an NO conversion to N_2 of 83% was obtained using 1200 ppM isobutanol at 200°C. This is believed to be the highest conversion reported to data without using NH_3 as the reductant. Other catalysts not containing copper were also tested, but their performance was inferior to this La-Cu-ZrO_2 catalyst.

21304 (DOE/PC/92535–T6) **Control of coal combustion SO_2 and NO_x emissions by in-boiler injection of CMA: Sixth quarterly project status report, 1 January 1994–31 March 1994.** Levendis, Y.A.; Wise, D.L.; Steciak, J.; Simons, G. Northeastern Univ., Boston, MA (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92535 ; FG22-89PC89776. Order Number DE94013067. Source: OSTI; NTIS; GPO Dep.

Conclusions: 1. Impregnation of pulverized coal particles by CMA and CA (and to leser extent MA) was found to increase the combustion temperature of both the volatile and the char phases. Effects of the additives on the burntime of either of the two phases could not be clearly detected. 2. The pretreatment of pulverized (75-90μm) and micronized (3.5μm mean) and beneficiated coals with CMA, CA or MA (at a Ca/S = 2) substantially reduced the emission of SO_2, at gas temperatures between 1250 to 1450 K, followed by a cool-down zone, in fuel-lean combustion (ϕ = 0.35-0.57). 3. The combustion of CMA-, CA-, or MA-treated pulverized coal in normal air suggested that all three sulfur caption mechanisms, mentioned in the introduction, were evident in the present experiments. 4. The results of experiments in normal air and in atmospheres containing 40% oxygen suggested that the release and subsequent sulfation of CaO and MgO aerosols may be the main mechanism for sulfur removal in the virtually ash-free micronized coal that was treated with CMA. 5. NO_x emissions were increased with higher gas temperatures. Micronized coal produced 25% less NO_x than pulverized coal. This could be due to its lower nitrogen

content and slightly more fuel-rich conditions for the micronized coal combustion, as well as localized fuel-rich conditions surrounding the small particles as the volatiles and char burn together. 6. The emissions of NO_x from CMA-treated pulverized coal were similar to those from untreated coal, whereas CMA-treated micronized coal released slightly more NO_x than it did when untreated. The latter event may be caused by the added fuel oxygen associated with the effective penetration of the CMA additive.

21305 (KFK-PEF–99) **Design of a periodically operated SCR reactor.** Kotter, M. (Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Chemische Verfahrenstechnik); Lintz, H.G.; Turek, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Jan 1993. 43p. (In German). Project Number PEF 90/001/3. Order Number DE94774228. Source: OSTI; NTIS (US Sales Only); INIS.

A new NO_x abatement process uses the rotating Ljungstroem air heater of the power plant for the selective catalytic reduction (SCR) of nitrogen monoxide with ammonia. For this purpose the air heater elements are covered by a catalytically active layer. The transformation can be carried out by simple replacement of the original air heater elements. Thus nitrogen monoxide control is possible without requiring major modifications of existing power plant equipment. Two oxidic catalysts have been developed to be employed in the different temperature sections of the air heater. The activity of the catalysts has been quantified with the aid of laboratory scale experiments. The results can be described using a simple expression for the rate of the chemical reaction. NO conversion and NH_3 slip to be expected in a catalytically active Ljungstroem heat exchanger are calculated with a reactor model taking into account the gas phase mass transfer resistances. The calculations show that the proposed device can be used if the NO concentration in the flue gas does not exceed 300 ppm. Recently Kraftanlagen AG, Heidelberg, installed a catalyst air heater system at Mandalay Generating Station in Oxnard, California. The comparison of the predicted results with preliminary experimental data proves the validity of the chosen reactor model. Under the given conditions NO conversions of more than 60% can be achieved maintaining the NH_3 slip below the specified value of 10 ppm. (orig.). 19 figs., 35 refs.

21306 (NEI-DK–1507) **Agglomeration of dusts and fly ash.** Kildesoe, J. (FLS miljoe A/S (Denmark)). Akademiet for de Tekniske Videnskaber, Lyngby (Denmark). 1993. 149p. (In Danish). Contract ENS-1323/90-0025. Order Number DE94771126. Source: OSTI; NTIS.

EFP-90.

The background for this thesis is the growing need to reduce the emission of submicron fly ash particle from coal fired power plants, partly due to the environmental and health-related problems, and partly due to the expected more rigorous statutory requirements concerning maximum limits for the emission of fly ash particles. At present, electrostatic precipitators are most efficient in relation to particles down to 1.0 μm. The objective of this project has been to enhance precipitation of submicron particles in the size range of 0.1 - 1.0 μm by studying the possibilities of developing equipment for the agglomeration of such particles. The electrostatic precipitator forms the basis of this project. Application of an electric quadrupole filed with monopolarly charged particles was considered to offer the best potential. For the purpose of the experimental work, a complete laboratory quadrupole agglomerator was built. It was attempted, on an experimental basis, to ascertain the potential agglomeration in a homogeneous alternating electric field. However, the measured degree of agglomeration was not high enouth to render it interesting in a commercial sense. It has been an objective of this project to find an optical method for particle sizing in connection with both the laboratory agglomerator and electrostatic precipitators in general. The most important methods for optical particle sizing are outlined. The tested instruments were TSI's APS 33B, Malvern's Aerosizer and the PCSV-P from Insitec. Based on these tests, it was concluded that the Insitec instrument, which measures the forward scattered intensity is the one that meets most of the requirements of this project, i.e. temperature range, particle concentration, size range, ease of use etc. It is concluded that it will be possible to use the instrument at particle concentrations up to around $5x10^9$ particles/cm^3. (EG)

21307 (OCDO–94012359) **Investigation of transport process involved in FGD: Final technical report for the third year, September 1992–August 1993.** Kadambi, J.R.; Kadaba, V.; Yurteri, C. Case Western Reserve Univ., Cleveland, OH (United States). Dept. of Mechanical and Aerospace Engineering. Sep 1993. 51p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

This report describes the work done in the third year of the project "Investigation of Transport Processes Involved in FGD". The objectives of this five year plan of study is to experimentally obtain a basic understanding of (1) turbulent flow structure of the mixing zone and its influence on particle dispersion, (2) the effect of particle loading on turbulent properties and mixing, (3) the effect of jet entrainment, (4) water spray-sorbent interaction, sorbent wetting and mixing, (5) investigate the flow field where certain ratios of jet velocity to flue gas velocity result in regions of negative flow and define onset of negative flow (6) sorbent reactivity in mixing zone and (7) effect of particle agglomeration. In the first two years of the project a sorbent injection facility which can simulate the conditions encountered in COOLSIDE set up was designed and built. Non-intrusive laser based diagnostic tools PDA/LDA was used for flow characterization of particle laden jet in cocurrent flows. All tasks for third year were addressed. The accomplishments for the third year include the following. For the investigation of Lime Laden Jet Flow, since no existing technique was capable of providing the simultaneous measurement of irregular shaped particle size and velocity, a new technique, TTLDV which utilizes the transit time in LDV measurement volume and the LDV velocity measurements to obtain simultaneous particle size and velocity measurements was developed. Better Sorbent Injection Methods and Optimized Injection Schemse were investigated. Progress was made in the development of Technique to Study Particulate Droplet Interactions, the task was not completed because of difficulties encountered due to differences in the refractive index of glass beads and water droplets. The investigations of flow reversal resulting from spray jet cocurrent flow interactions was completed.

21308 (OCDO–94012361) **Effect of sorbent attrition on utilization: Final report.** Keener, T.C. (Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering); Khang, S.J.; Li, G. Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering. 30 Sep 1993. 61p. Sponsored by Ohio State Government, Columbus, OH (United States). Project OCRC/90-1.7. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The overall objective for 1992-1993 was to investigate ways of using chemical attrition to improve dolomitic sorbent utilization for duct injection processes. It is known that one of the primary mechanisms for poor sorbent utilization lies in the fact that the products of SO_2-sorbent reactions have such large molar volumes that they plug the pores necessary for SO_2 to diffuse into the particle interior. Any method that may cause the fracture of used sorbent particles will thus expose fresh un-reacted surface of sorbent and result in available sorbent recovery. There are several mechanisms that may cause the breakage of particles. External mechanical stress may be exerted on a particle and cause particle fracture when it exceeds the cohesive forces to prevent the breakage. Heat and pressure can also induce particle fracture. In addition, chemical reaction is also a very important factor in leading to particle fracture. Among many sorbents currently used in desulfurization processes, dolomitic lime may be a good candidate for use in medium temperature duct injection. Dolomites are characterized by a large portion of magnesium (instead of high calcium) in the crystal structure of common limestones. Because of the special composition of dolomitic lime and its reactions with flue gas constituents under medium temperature duct injection conditions, a unique structure is formed for spent dolomitic particles that provides for the potential of recovering available sorbent just by hydration-induced particle

fracture. By re-injecting the recovered sorbent, it is expected that a high sorbent utilization can be obtained.

21309 (OCDO–94012363) **Kinetics studies, thermal decomposition and carbonation: Final report.** Cincinnati Univ., OH (United States). Dept. of Chemical Engineering. Sep 1993. 57p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The purpose of this project is to study the fundamental nature of the sorbent reactivity and reaction kinetics in the medium temperature range from 600 to 1200°F available in the convective pass of a boiler upstream of the economizer, where dry sorbents and anhydrous ammonia are injected to reduce SO_2, and NO_2, from the flue gas. The following conclusions are drawn from the results of the third year of study. The dehydration conversion increased with reaction temperature from 3% at 600°F to 36% at 1100°F. The fresh CaO from the dehydration reaction of $Ca(OH)_2$ is very active in air. The carbonation conversion increases slightly with residence time from 50ms to 75ms. In the simultaneous carbonation/sulfation reaction the carbonation conversion increased continuously with the reaction temperature from 600°F to 1100°F. By comparing the sulfation conversion of $Ca(OH)_2$ and CaO at 900°F and residence times from 50 to 75ms, it is found that the sulfation conversion of CaO at this temperature range was significant and could not be ignored. The carbonation reaction took place simultaneously with sulfation reaction under the fixed bed and drop-tube reactor conditions.

21310 (OCDO–94012364) **Handling, transport and dispersion of sorbent powder for in-furnace injection: Third year final report.** Fan, Liang-Shih (Ohio State Univ., Columbus, OH (United States)); Bavarian, F.; Lee, R.J.; Hsia, Chung-wei; Abou-Zeida, E.; Jiang, Peijun; Dastidar, A.G.; Mahuli, S. Ohio Coal Development Office, Columbus, OH (United States). Sep 1993. 60p. Sponsored by Ohio State Government, Columbus, OH (United States). Grant OCRC/91-1.2. Source: OSTI; Ohio Coal Development Office, 77 S. High St., P.O. Box 1001, Columbus, OH 43266-0001.

The purpose of this study is to explain, using fundamental theories of interparticle forces, the difference in transport and dispersion between various sorbents. This project is closely tied with 1.1 through the focus of maximum utilization of sorbent materials used in the LIMB process. Interparticle forces lead to agglomeration or removal to transport tube walls of the sorbent fine particles, reducing sulfur removal capabilities. In the first and second years, the pneumatic transport of sorbent powders was investigated for four typical sorbent materials, calcium carbonate, dolomite, dolomitic hydrate and hydrated lime. Results indicate that hydrated lime has the best dispersion and flowability. Studies in the third year involved investigating improving the performance of hydrated lime with additives. The addition of calcium liposulfonate to the water of hydration appears to improve both the dispersibility and reactivity of the resulting product hydrate. Increased reactivity is closely tied to available surface area for reaction, as expected. However, in applications where powder flowability becomes important, such as in the use of hydrate in flue-gas desulfurization, a balance between the flowability and surface area must be considered. If the powder has poor flowability, the added surface area may not be utilized. Powder dispersion and the high-temperature are used to determine the dispersibility of the modified and unmodified sorbents at room temperature and at typical furnace temperatures. Results verify that an increase in dispersibility is realized with the liposulfonate-modified hydrate. Phase 1 results show this increased dispersibility to be due to electrostatic repulsion between liposulfonate molecules on the surface of the dry powder.

21311 (OCDO–94012365) **Kinetics and structural evolution of sorbents at high temperatures: Final report, September 1, 1992–August 31, 1993.** Fan, Liang-Shih; Dastidar, A.G.; Mahuli, S.; Agnihotri, R. Ohio State Univ., Columbus, OH (United States). Dept. of Chemical Engineering. Sep 1993. 47p. Sponsored by Ohio State Government, Columbus, OH (United States). Grant CDO/R-87-2C/B. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The focus of this project is on furnace sorbent injection technology using dry, calcium-based sorbents for flue gas desulfurization. The goal is to provide fundamental research kinetics and the effects of sorbent properties, aimed at improving SO_2 removal and increasing sorbent utilization in a cost-effective fashion. The main focus of the third year work has been to obtain fundamental kinetic data for calcination, sintering and sulfation of calcium hydroxide sorbent. The results, their interpretation, and discussions are the primary focus of this report. Other major portions of this year's work covered in the report include the additions and modifications made to the experimental system, and preliminary results of the studies with modified $Ca(OH)_2$. Most of the reactor system and the analytical and measurement techniques were developed in the second year and formed the necessary framework for realizing the project goal. A few design and experimental constraints necessitated modifications and additions which were made in the beginning of this year. A continuous micro-feeder was built in order to feed very small quantities of sorbent, which is essential to maintain differential conditions with respect to SO_2 during sulfation experiments. The particle collection probe was modified with an insulating ceramic cover and cap, in order to reduce its cooling effect and achieve better isothermality within the reactor. A cascade cyclone sampler was added to replace the impactor because the particle loading capacity of the impactor was not sufficient to hold enough powder required for post-reaction analyses.

2005 Environmental Aspects

21312 (DTH-LA–45) **Active reduction of the dominant clear tone component of the noise pollution from power plant chimneys: Theoretical investigation and computer simulation.** Laugesen, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Akustik. 1992. 59p. (In Danish). Order Number DE94771148. Source: OSTI; NTIS; INIS.

A description of the second phase of the project dealing with active reduction of an irritating dominant clear tone component of noise pollution from power plant chimneys. The investigation is based on a theoretical model and calculations show that in principle it is possible to significantly reduce the radiated acoustic effect from the chimney if the active noise-reducing system covers a secondary source for each type of sound wave that can spread within the chimney at the frequency in question. The system should cover a few more fault microphones than secondary sources and they should be located in the residual field's area of minimal pressure. The noise should be reduced so much that only distortion, quantization and turbulence noise set the limits for reduction. (AB) (18 refs.)

21 NUCLEAR POWER REACTORS AND ASSOCIATED PLANTS

21313 (HW–72856) **Reactivity and efficiency trends vs. operating trends for C, H, KE, and KW reactors - 1956 through 1960.** Perl, E.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Mar 1962. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013678. Source: OSTI; NTIS; GPO Dep.

Declassified.

Changes in operation and corresponding changes in the reactivity status of Hanford reactors are the result of a continuing effort to improve operating efficiency. Trends data related to these changes in operation and reactivity have been published previously for the periods from 1950 through 1959. The purpose of this report is to include trends data for 1960. All included data were selected from the sources listed. Bar graphs in the first part of the report show yearly averages of selected data, and the line graphs in the second part show the interrelationship of some of the yearly averages depicted in the first part. The tables in Appendix I show maximum, average, and minimum values. This document presents trends data for C, H, KE, and KW reactors. A second document, HW-72855, presents trends data for B, D, DR, and F reactors.

21314 (IAEA-TECDOC–737, pp. 119-124) **Relationship between safety culture and PSA.** Joksimovich, V. (Accident Prevention Group, San Diego, CA (United States)). International Atomic Energy Agency, Vienna (Austria). Mar 1994. (CONF-9209300–: Advances in reliability analysis and probabilistic safety assessment, Budapest (Hungary), 7-11 Sep 1992). In *Advances in reliability analysis and probabilistic safety assessment for nuclear power reactors: Report of a technical committee meeting held in Budapest, 7-11 September 1992.* 264p. Order Number DE94624677. Source: OSTI; NTIS (US Sales Only); INIS.

A primary focus of nuclear safety is prevention of large releases of radioactivity in the case of low probability severe accidents. An analysis of the anatomy of nuclear (Chernobyl, TMI-2) and non-nuclear (Challenger, Bhopal, Piper Alpha, etc.) severe accidents yields four broad categories of root causes, or 4M (abbreviated 4M): man (operating crew response), machine (design with its basic flaws), media (natural phenomena, operational considerations, political environment, commercial pressures, etc.) providing triggering events and management (basic organization safety culture flaws). A strong management can minimize contributions of man, machine and media to the risk arising from operation of hazardous facilities. One way management can have powerful positive influence is through the establishment of a proper safety culture. The terms safety culture is defined by virtue of employing IAEA's International Safety Advisory Group (INSAG) and APG's (arrived through work sponsored by the Nuclear Regulatory Commission) definitions. An example of U.S. Nuclear Utility safety culture is discussed. Like any other human endeavor, the manner in which people act is conditioned by requirements set at a top level. Policies promoted at the CEO level create the working environment and condition behavior of individuals in the trenches. A summary of the safety culture initiatives within the nuclear utility illustrates commitment to the safety culture. Other powerful examples are the existence of independent safety oversight or risk group directly reported to the CEO and a requirement for submittal of annual nuclear safety assurance reports. The paper concludes claiming that an integrated risk management program imbedded in an effective safety culture will lead management of a nuclear utility to achieve both economic and safety goals while reducing strain on management personnel and operating budgets, primarily through an effective integration process. (author). 17 refs, 1 fig.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 20819, 20938, 21594, 21596, 21610, 21611, 21614, 21615, 21617, 21618, 21621, 21622, 21623, 21624, 21625, 21626, 21627, 21628, 21629, 21630, 21631, 21632, 21633, 21634, 21635, 21636, 21639, 21640, 21641, 21643, 23308

21315 (BNL-NUREG–60269) **The effects of aging on Boiling Water Reactor core isolation cooling system.** Lee, Bom Soon. Brookhaven National Lab., Upton, NY (United States). [1994]. 12p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940613–23: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94013028. Source: OSTI; NTIS; INIS; GPO Dep.

A study was performed to assess the effects of aging on the Reactor Core Isolation Cooling system in commercial Boiling Water Reactors. This study is part of the Nuclear Plant Aging Research program sponsored by the US Nuclear Regulatory Commission. The failure data, from national databases, as well as plant specific data were reviewed and analyzed to understand the effects of aging on the RCIC system. This analysis identified important components that should receive the highest priority in terms of aging management. The aging characterization provided information on the effects of aging on component failure frequency, failure modes, and failure causes.

21316 (CONF-940424–32) **BUGLE-93 (ENDF/B-VI) cross-section library data testing using shielding benchmarks.** Hunter, H.T.; Slater, C.O.; White, J.E. Oak Ridge National Lab., TN (United States). [1994]. 9p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract A .05-84OR21400. From 8. international conference on radiation shielding; Arlington, TX (United States); 24-27 Apr 1994. Order Number DE94012320. Source: OSTI; NTIS; INIS; GPO Dep.

Several integral shielding benchmarks were selected to perform data testing for new multigroup cross-section libraries compiled from the ENDF/B-VI data for light water reactor (LWR) shielding and dosimetry. The new multigroup libraries, BUGLE-93 and VITAMIN-B6, were studied to establish their reliability and response to the benchmark measurements by use of radiation transport codes, ANISN and DORT. Also, direct comparisons of BUGLE-93 and VITAMIN-B6 to BUGLE-80 (ENDF/B-IV) and VITAMIN-E (ENDF/B-V) were performed. Some benchmarks involved the nuclides used in LWR shielding and dosimetry applications, and some were sensitive specific nuclear data, i.e. iron due to its dominant use in nuclear reactor systems and complex set of cross-section resonances. Five shielding benchmarks (four experimental and one calculational) are described and results are presented.

21317 (EGG–10617-1231) **An aerial radiological survey of the Millstone Nuclear Power Station and surrounding area.** Vojtech, R.J. EG and G, Inc., Goleta, CA (United States). Mar 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. Order Number DE94012407. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted during the period of September 10 to 18, 1990, over a 40-square-mile (104-square-kilometer) area surrounding the Millstone Nuclear Power Station (MNPS). The MNPS is located on the Long Island Sound shoreline, three kilometers south of Waterford, Connecticut. The purpose of the survey was to measure and document the terrestrial gamma ray environment of the plant and surrounding areas. A contour map showing radiation exposure rates at 1 meter above ground level was constructed from the aerial data and overlaid on an aerial photograph and a United States Geological Survey map of the area. The exposure rates within the survey region are quite uniform. The area is characterized by an exposure rate of 10-12 microroentgens per hour including an estimated cosmic ray contribution of 3.6 μR/h. This is typical of natural background. The only exception to the natural background readings is the Millstone station itself, which is characterized by an exposure rate consistent with the standard operation of the reactor units. Radionuclide assays of soil samples and pressurized-ion-chamber gamma ray measurements were obtained at five locations within the survey boundaries. These measurements were taken in support of, and are in agreement with, the aerial data. The radiological environment near the plant is consistent with normal plant operation.

21318 (HW–58002) **New production reactor emergency power system.** Mollerus, F.J. Pacific Northwest Lab., Richland, WA (United States). 30 Oct 1958. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013680. Source: OSTI; NTIS; GPO Dep.

The attached discussion will show why NPR emergency generators should be rated at 15,000 KW (18,750 MVA) each, instead of 10,000 KW (12,500 MVA) as presently specified. The operating plan provides flexibility plus two advantages: (1) Provision for control of system peak loads, and (2) Self-sustaining operation under certain conditions.

21319 (NEDO–32361) **Study of plutonium disposition using existing GE advanced Boiling Water Reactors.** General Electric Co., San Jose, CA (United States). 1 Jun 1994. 581p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-93SF19681. Order Number DE94013217. Source: OSTI; NTIS; INIS; GPO Dep.

The end of the cold war and the resulting dismantlement of nuclear weapons has resulted in the need for the US to dispose of 50 to 100 metric tons of excess of plutonium in a safe and proliferation resistant manner. A number of studies, including the recently released National Academy of Sciences (NAS) study, have recommended conversion of plutonium into spent nuclear fuel with its high radiation barrier as the best means of providing permanent conversion and long-term diversion resistance to this material. The NAS study "Management and Disposition of Excess Weapons Plutonium identified Light Water Reactor spent fuel as the most readily achievable and proven form for the disposition of excess weapons

plutonium. The study also stressed the need for a US disposition program which would enhance the prospects for a timely reciprocal program agreement with Russia. This summary provides the key findings of a GE study where plutonium is converted into Mixed Oxide (MOX) fuel and a typical 1155 MWe GE Boiling Water Reactor (BWR) is utilized to convert the plutonium to spent fuel. A companion study of the Advanced BWR has recently been submitted. The MOX core design work that was conducted for the ABWR enabled GE to apply comparable fuel design concepts and consequently achieve full MOX core loading which optimize plutonium throughput for existing BWRs.

21320 (NUREG/CR–5967) **Development and application of degradation modeling to define maintenance practices.** Stock, D. (Brookhaven National Lab., Upton, NY (United States)); Samanta, P.; Vesely, W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Brookhaven National Lab., Upton, NY (United States). Jun 1994. 60p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52353). Source: OSTI; NTIS; GPO; INIS.

This report presents the development and application of component degradation modeling to analyze degradation effects on reliability and to identify aspects of maintenance practices that mitigate degradation and aging effects. Using continuous time Markov approaches, a component degradation model is discussed that includes information about degradation and maintenance. The component model commonly used in probabilistic risk assessments is a simple case of this general model. The parameters used in the general model have engineering interpretations and can be estimated using data and engineering experience. The generation of equations for specific models, the solution of these equations, and a methodology for estimating the needed parameters are all discussed. Applications in this report show how these models can be used to quantitatively assess the benefits that are expected from maintaining a component, the effects of different maintenance efficiencies, the merits of different maintenance policies, and the interaction of surveillance test intervals with maintenance practices.

21321 (NUREG/CR–6176) **Review of environmental effects on fatigue crack growth of austenitic stainless steels.** Shack, W.J. (Argonne National Lab., IL (United States)); Kassner, T.F. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Reactor Regulation; Argonne National Lab., IL (United States). May 1994. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (ANL–94/1). Source: OSTI; NTIS; INIS; GPO.

Fatigue and environmentally assisted cracking of piping, pressure vessel cladding, and core components in light water reactors are potential concerns to the nuclear industry and regulatory agencies. The degradation processes include intergranular stress corrosion cracking of austenitic stainless steel (SS) piping in boiling water reactors (BWRs), and propagation of fatigue or stress corrosion cracks (which initiate in sensitized SS cladding) into low-alloy ferritic steels in BWR pressure vessels. Crack growth data for wrought and cast austenitic SSs in simulated BWR water, developed at Argonne National Laboratory under US Nuclear Regulatory Commission sponsorship over the past 10 years, have been compiled into a data base along with similar data obtained from the open literature. The data were analyzed to develop corrosion-fatigue curves for austenitic SSs in aqueous environments corresponding to normal BWR water chemistries, for BWRs that add hydrogen to the feedwater, and for pressurized water reactor primary-system-coolant chemistry.

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 20819, 21315, 21316, 21317, 21319, 21320, 21594, 21596, 21601, 21614, 21615, 21616, 21618, 21619, 21620, 21621, 21622, 21624, 21625, 21626, 21627, 21628, 21629, 21630, 21631, 21632, 21633, 21634, 21635, 21637, 21638, 21639, 21640, 21641, 21643, 21644, 21645, 23308

21322 (DOE/SF/19090–T2) **Advanced Light Water Reactor Plants System 80+™ Design Certification Program: Annual progress report, October 1, 1992–September 30, 1993.** Combustion Engineering, Inc., Windsor, CT (United States). ABB Combustion Engineering Nuclear Power. [1993]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-91SF19090. Order Number DE94010675. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide a status of the progress that was made towards Design Certification of System 80+™ during the US government's 1993 fiscal year. The System 80+ Advanced Light Water Reactor (ALWR) is a 3931 MW_t (1350 MWe) Pressurized Water Reactor (PWR). The design consists of an essentially complete plant. It is based on evolutionary improvements to the Standardized System 80 nuclear steam supply system in operation at Palo Verde Units 1, 2, and 3, and the Duke Power Company P-81 balance-of-plant (BOP) that was designed and partially constructed at the Cherokee plant site. The System 80/P-81 original design has been substantially enhanced to increase conformance with the EPRI ALWR Utility Requirements Document (URD). Some design enhancements incorporated in the System 80+ design are included in the four units currently under construction in the Republic of Korea. These units form the basis of the Korean standardization program. The full System 80+ standard design has been offered to the Republic of China, in response to their recent bid specification. The ABB-CE Standard Safety Analysis Report (CESSAR-DC) was submitted to the NRC and a Draft Safety Evaluation Report was issued by the NRC in October 1992. CESSAR-DC contains the technical basis for compliance with the EPRI URD for simplified emergency planning. The Nuclear Steam Supply System (NSSS) is the standard ABB-Combustion Engineering two-loop arrangement with two steam generators, two hot legs and four cold legs each with a reactor coolant pump. The System 80+ standard plant includes a sperical steel containment vessel which is enclosed in a concrete shield building, thus providing the safety advantages of a dual containment.

21323 (ENEA-RT-INN–92-35) **Parametric study on burnup-credit of simple LWR spent fuel cell in context of new validated criticality analysis methodology development.** Siciliano, F. (ENEA, Rotondella (Italy). Centro Ricerche Energia Trisaia - Area Energia e Innovazione). ENEA, Casaccia (Italy). Centro Ricerche Energia. Sep 1993. 32p. (RT/INN–92-35). Order Number DE94775325. Source: OSTI; NTIS (US Sales Only).

A new validated criticality analysis methodology is arising under the pressure of the nuclear industry moving towards increased fuel enrichment in order to attain higher burnups in LWRs (light water reactors). The present way of performing criticality safety analyses is based upon the 'fresh fuel' assumption in any kind of modelling of storage pool, transport cask and reprocessing plant systems. It is well known that excessively large criticality margins are obtained when LWR fuel is considered instead of the spent one, i.e., when higher actinides and fission products are not taken into account in the calculations a burnup-credit is thought to be available. In this note, using a simple PWR (pressurized water cooled reactors) spent fuel cell geometry, a quantitative 'measure' of these safe criticality margins (as 'fresh fuel' case 1 comparison) is carried out in terms of K infinite evaluations of eight cases. The following parameters were applied: 30 and 40 Gwd/t burnup and 1 and 5 cooling time periods. Statistically significant differences were obtained for all cases using the applied parameter ranges within 3 standard deviation limits.

21324 (JAERI-M–94-003) **OECD/NEA Burnup Credit Criticality Benchmark: Result of phase-1A.** Takano, Makoto (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 151p. Order Number DE94770595. Source: OSTI; NTIS; INIS.

The report describes the final result of the phase-1A of the Burnup Credit Criticality Benchmark conducted by OECD/NEA. The phase-1A benchmark problem is an infinite array of a simple PWR spent fuel rod. The analysis has been performed for the PWR spent fuels of 30 and 40 GWd/t after 1 and 5 years of cooling time. In total, 25 results from 19 institutes of 11 countries have been

submitted. For the nuclides in spent fuel, 7 major actinides and 15 major fission products (FP) are selected for the benchmark calculation. In the case of 30 GWd/t burnup, it is found that the major actinides and the major FPs contribute more than 50% and 30% of the total reactivity loss due to burnup, respectively. Therefore, more than 80% of the reactivity loss can be covered by 22 nuclides. However, the larger deviation among the reactivity losses by particpants has been found for cases including EPs than the cases with only actinides, indicating the existence of relatively large uncertainties in FP cross sections. The large deviation seen also in the case of the fresh fuel has been found to reduce sufficiently by replacing the cross section library from ENDF-B/IV with that from ENDF-B/V and taking the known bias of MONK6 into account. (author).

21325 (JAERI-M–94-008) **Void fraction in a PWR fuel bundle during reflood phase: Evaluation of equivalent diameter effect by air water test.** Iguchi, Tadashi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 38p. (In Japanese). Order Number DE94770593. Source: OSTI; NTIS; INIS.

Effect of equivalent diameter on void fraction in a PWR fuel bundle under low mass flow condition was evaluated by air water test result. The reason why void fraction in a bundle flow passage was lower under low mass flow condition than that in a tubular flow passage was investigated. In addition, applicability of Cunningham-Yeh correlation, which was demonstrated to give good prediction on void fraction of steam water mixture in a bundle flow passage under low mass flow condition, to air water mixture was investigated. Experimental result indicated that void fraction was lower with increase in the equivalent diameter and the effect of the equivalent diameter was quantitatively described by a term which was known to be adequate for a tubular flow passage. Through a present flow pattern observation, it was considered that formation of slugs with complicated geometries in a bundle flow passage and nonuniform flow conditions among subchannels were main reasons of difference in void fractions between in a bundle and in a tube. Void fraction in a present air water test was predicted within ±15% error band with Cunningham-Yeh correlation by newly introducing terms describing the equivalent diameter effect and the viscosity effect. (author).

21326 (LTKK-EN-A–15) **Relap assessment with Rewet-III natural circulation experiments.** Kalli, H.; Hyvaerinen, J. Lappeenranta Univ. of Technology (Finland). Dept. of Energy Technology. 1989. 17p. Order Number DE94626332. Source: OSTI; NTIS; INIS.

The Technical Research Centre of Finland in cooperation with the Lappeenranta University of Technology has built a scaled facility, REWETT-III, to investigate the natural circulation phenomena in the VVER-440-type PWRs in operation in Loviisa, Finland. The present paper summarizes the experience gained in the RELAP5/MOD1-EUR and RELAP5/MOD2 calculations of selected REWETT-III single- and two-phase natural circulation experiments. (orig.). (6 refs., 5 figs., 2 tabs.).

21327 (NUREG/CR–6185) **TMI-2 instrument nozzle examinations at Argonne National Laboratory, February 1991–June 1993.** Neimark, L.A.; Shearer, T.L.; Purohit, A.; Hins, A.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Argonne National Lab., IL (United States). [1994]. 154p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (ANL–94/5). Source: OSTI; NTIS; INIS; GPO.

The accident at the Three Mile Island Unit 2 (TMI-2) reactor in March 1979 resulted in the relocation of approximately 19,000 kg of molten core material to the lower head of the reactor vessel. This material caused extensive damage to the instrument guide tubes and nozzles and was suspected of having caused significant metallurgical changes in the condition of the lower head itself. These changes and their effect on the margin-to-failure of the lower head became the focal point of an investigation co-sponsored by the United States Nuclear Regulatory Commission (NRC) and the Organization for Economic Co-operation and Development (OECD). The TMI-2 Vessel Investigation Project (VIP) was formed to determine the metallurgical state of the vessel at the lower head and to assess the margin-to-failure of the vessel under the conditions existing during the accident. This report was prepared under the auspices of the OECD/NEA Three Mile Island Vessel Investigation Project. Under the auspices of the VIP, specimens of the reactor vessel were removed in February 1990 by MPR Associates, Inc. In addition to these specimens, fourteen instrument nozzle segments and two segments of instrument guide tubes were retrieved for metallurgical evaluation. The purpose of this evaluation was to provide additional information on the thermal conditions on the lower head that would influence the margin-to-failure, and to provide insight into the progression of the accident scenario, specifically the movement of the molten fuel across the lower head.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 20822, 20823, 21361, 21362, 21363, 21364, 21365, 21366, 21407, 21410, 21430, 21435, 21581, 21582, 21600, 21604, 22688, 23284, 23285, 23286, 23287, 23291, 23294, 23295, 23297

21328 (ORNL/TM–12711) **Applications of Monte Carlo methods for the analysis of MHTGR case of the PROTEUS benchmark.** Difilippo, F.C. Oak Ridge National Lab., TN (United States). Apr 1994. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94010153. Source: OSTI; NTIS; GPO Dep.

Monte Carlo methods, as implemented in the MCNP code, have been used to analyze the neutronics characteristics of benchmarks related to Modular High Temperature Gas-Cooled Reactors. The benchmarks are idealized versions of the Japanes (VHTRC) and Swiss (PROTEUS) facilities and an actual configurations of the PROTEUS Configuration I experiment. The purpose of the unit cell benchmarks is to compare multiplication constants, critical bucklings, migration lengths, reaction rates and spectral indices. The purpose of the full reactors benchmarks is to compare multiplication constants, reaction rates, spectral indices, neutron balances, reaction rates profiles, temperature coefficients of reactivity and effective delayed neutron fractions. All of these parameters can be calculated by MCNP, which can provide a very detailed model of the geometry of the configurations, from fuel particles to entire fuel assemblies, using at the same time a continuous energy model. These characteristics make MCNP a very useful tool to analyze these MHTGR benchmarks. We have used the MCNP latest version, 4.x, eld = 01/12/93 with an ENDF/B-V cross section library. This library does not yet contain temperature dependent resonance materials, so all calculations correspond to room temperature, T = 300°K. Two separate reports were made – one for the VHTRC, the other for the PROTEUS benchmark.

2104 Power Reactors, Nonbreeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 21391

21329 (INIS-JP–018, pp. 1397-1402) **Development of fresh fuel packaging for ATR demonstration reactor.** Kurakami, J. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works); Kurita, I. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

Related to development of the demonstration advanced thermal reactor, it is necessary and important to develop transport packaging which is used for transporting fresh fuel assemblies. Therefore, the packaging is now being developed in Power Reactor and Nuclear Fuel Development Corporation (PNC). Currently, PNC is fabricating two prototype packagings based on the final design, and land cruising and vibration tests, handling performance tests and prototype packaging tests will be executed with prototype packagings in order to experimentally confirm the soundness of

packaging and its contents and the propriety of design technique. This paper describes the summary of general specifications and structures of this packaging and the summary of preliminary safety analysis of package. (J.P.N.).

2105 Power Reactors, Breeding

Refer also to citation(s) 21372

21330 (ANL/TD/CP–82911) **Behavior of actinides in the Integral Fast Reactor fuel cycle.** Courtney, J.C. (Louisiana State Univ., Baton Rouge, LA (United States). Nuclear Science Center); Lineberry, M.J. Argonne National Lab., Idaho Falls, ID (United States). Technology Development Div.; Louisiana State Univ., Baton Rouge, LA (United States). Nuclear Science Center. [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ; FG02-89ER12896. (CONF-940301–32: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994). Order Number DE94012467. Source: OSTI; NTIS; INIS; GPO Dep.

The Integral Fast Reactor (IFR) under development by Argonne National Laboratory uses metallic fuels instead of ceramics. This allows electrorefining of spent fuels and presents opportunities for recycling minor actinide elements. Four minor actinides (^{237}Np, ^{240}Pu, ^{241}Am, and ^{243}Am) determine the waste storage requirements of spent fuel from all types of fission reactors. These nuclides behave the same as uranium and other plutonium isotopes in electrorefining, so they can be recycled back to the reactor without elaborate chemical processing. An experiment has been designed to demonstrate the effectiveness of the high-energy neutron spectra of the IFR in consuming these four nuclides and plutonium. Eighteen sets of seven actinide and five light metal targets have been selected for ten day exposure in the Experimental Breeder Reactor-2 which serves as a prototype of the IFR. Post-irradiation analyses of the exposed targets by gamma, alpha, and mass spectroscopy are used to determine nuclear reaction-rates and neutron spectra. These experimental data increase the authors' confidence in their ability to predict reaction rates in candidate IFR designs using a variety of neutron transport and diffusion programs.

21331 (CONF-940424–33) **Shielding analysis of the LMR in-vessel fuel storage experiments.** Bucholz, J.A. Oak Ridge National Lab., TN (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 8. international conference on radiation shielding; Arlington, TX (United States); 24-27 Apr 1994. Order Number DE94012328. Source: OSTI; NTIS; INIS; GPO Dep.

The In-Vessel Fuel Storage (IVFS) experiments analyzed in this paper were conducted at the Oak Ridge National Laboratory's Tower Shielding Reactor (TSR) as part of the Japanese-American Shielding Program for Experimental Research (JASPER). These IVFS experiments were designed to study source multiplication and three-dimensional effects related to in-vessel storage of spent fuel elements in liquid metal reactor (LMR) systems. The present paper describes the 2- and 3-D calculations and results corresponding to a limited subset of those IVFS experiments in which the US LMR program had a particular interest.

21332 (ENEA-RT-NUCL–92-07) **New computative approach to feasibility of higher actinides burning in fast reactor using code actinides.** Siciliano, F. (ENEA, Rotondella (Italy). Centro Ricerche Energia Trisaia - Area Nucleare). ENEA, Rotondella (Italy). Centro Ricerche Energia Trisaia - Area Nucleare. May 1993. 56p. (RT/NUCL–92-07). Order Number DE94775303. Source: OSTI; NTIS (US Sales Only).

In the first part of this paper, the point source model code, Actinides, is introduced as an ad hoc program developed for evaluating thermal and fast range fuel depletion, as well as, higher actinide build-up concentrations. Subsequently, further calculations can be accomplished on thermal and fast range produced actinide wastes both in terms of concentrations and properly set out indicators to establish the burning effectiveness. Theoretically, it has been predicted that enhanced consumption levels of the thermal reactor wastes are achievable as original activity cutting down or ratios (at least of order of 1.0e06 or greater). A major transmutation degree is practicable when the main sources of higher actinide concentrations during any irradiation period are taken away from the original waste production, i.e., removing Pu and especially U isotopes by reprocessing within reach or achievable by research and development. Moreover, the strong volume reduction of some processes could lead to bulk actinide waste contents burning by the design of proper matrixes.

21333 (INIS-JP–018, pp. 1390-1396) **Development of fresh fuel packaging for a prototype fast breeder reactor 'MONJU'.** Kurakami, J. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works); Ouchi, Y.; Maeda, K. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

PNC has developed the packaging to transport fresh fuel assemblies from PFPF to the reactor site. The paper describes general specifications and characteristics of the packaging and the summary of prototype packaging tests. (J.P.N.).

21334 (KFK–5250) **NACOWA experiments on LMFBR cover gas aerosols, heat transfer, and fission product enrichment.** Minges, J.; Schuetz, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Lab. fuer Aerosolphysik und Filtertechnik (LAF); Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Dec 1993. 133p. Order Number DE94773756. Source: OSTI; NTIS (US Sales Only); INIS.

Fifteen different NACOWA test series were carried out. The following items were investigated: sodium mass concentration in the cover gas, sodium aerosol particle size, radiative heat transfer across the cover gas, total heat transfer across the cover gas, sodium deposition on the cover plate, temperature profiles across the cover gas, phenomena if the argon cover gas is replaced by helium, enrichment of cesium, iodine, and zinc in the aerosol and in the deposits. The conditions were mainly related to the design parameters of the EFR. According to the first consistent design, a pool temperature of 545 C and a roof temperature of only 120 C were foreseen at a cover gas height of 85 cm. The experiments were carried out in a stainless steel test vessel of 0.6 m diameter and 1.14 m height. Pool temperature (up to 545 C), cover gas height (12.5 cm, 33 cm, and others), and roof temperature (from 110 C to 450 C) were the main parameters. (orig./HP)

2106 Power Reactors, Mobile, Propulsion, Package, and Transportable

21335 (BNWL-CC–442) **Letter to P. G. Holsted, re: BNWL–118 in answer to BNWI-160.** Tipton, C.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Jan 1966. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012870. Source: OSTI; NTIS; GPO Dep.

Declassified.

This memorandum provides a discussion of the classification of materials pertaining to submarine nuclear reactors as mentioned in the Reactor Design Handbook.

21336 (GA-A–21511) **TFE Verification Program: Semiannual report for the period ending September 30, 1993.** General Atomics, San Diego, CA (United States). Jan 1994. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16298. Order Number DE94009870. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the final semiannual progress report for the TFE Verification. A decision was made in August 1993 to begin a Close Out Program on October 1, 1993. Final reports summarizing the design analyses and test activities of the TFE Verification Program will be written, stand-alone documents for each task. The objective of the semiannual progress report is to summarize the technical results

obtained during the latest reporting period. The information presented herein includes evaluated test data, design evaluations, the results of analyses and the significance of results.

21337 (GA-A–21590) **Conceptual design: Final report: TFE Verification Program.** General Atomics, San Diego, CA (United States). Mar 1994. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16298. Order Number DE94012469. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the TFE Conceptual Design, which provided the design guidance for the TFE Verification program. The primary goals of this design effort were: (1) establish the conceptual design of an in-core thermionic reactor for a 2 Mw(e) space nuclear power system with a 7-year operating lifetime; (2) demonstrate scalability of the above concept over the output power range of 500 kW(e) to 5 MW(e); and (3) define the TFE which is the basis for the 2 MW (e) reactor design. This TFE specification provided the basis for the test program. These primary goals were achieved. The technical approach taking in the conceptual design effort is discussed in Section 2, and the results are discussed in Section 3. The remainder of this introduction draws a perspective on the role that this conceptual design task played in the TFE Verification Program.

21338 (GA-A–21595) **Cesium reservoir and interconnective components: Final test report: TFE Verification Program.** General Atomics, San Diego, CA (United States). Mar 1994. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16298. Order Number DE94012470. Source: OSTI; NTIS; INIS; GPO Dep.

The program objective is to demonstrate the technology readiness of a TFE (thermionic fuel element) suitable for use as the basic element in a thermionic reactor with electric power output in the 0.5 to 5.0 MW range. A thermionic converter must be supplied with cesium vapor for two reasons. Cesium atoms adsorbed on the surface of the emitter cause a reduction of the emitter work function to permit high current densities without excessive heating of the emitter. The second purpose of the cesium vapor is to provide space-charge neutralization in the emitter-collector gap so that the high current densities may flow across the gap unattenuated. The function of the cesium reservoir is to provide a source of cesium atoms, and to provide a reserve in the event that cesium is lost from the plasma by any mechanism. This can be done with a liquid cesium metal reservoir in which case it is heated to the desired temperature with auxiliary heaters. In a TFE, however, it is desirable to have the reservoir passively heated by the nuclear fuel. In this case, the reservoir must operate at a temperature intermediate between the emitter and the collector, ruling out the use of liquid reservoirs. Integral reservoirs contained within the TFE will produce cesium vapor pressures in the desired range at typical electrode temperatures. The reservoir material that appears to be the best able to meet requirements is graphite. Cesium intercalates easily into graphite, and the cesium pressure is insensitive to loading for a given intercalation stage. The goals of the cesium reservoir test program were to verify the performance of Cs-graphite reservoirs in the temperature-pressure range of interest to TFE operation, and to test the operation of these reservoirs after exposure to a fast neutron fluence corresponding to seven year mission lifetime. In addition, other materials were evaluated for possible use in the integral reservoir.

2107 Regulation and Licensing

Refer also to citation(s) 21613

21339 (NUREG–0750-Vol.39-No.3) **Nuclear Regulatory Commission issuances.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Mar 1994. 103p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from Commission (CLI), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

21340 (NUREG–1350-Vol.6) **Nuclear Regulatory Commission Information Digest 1994 edition: Volume 6.** Stadler, L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Budget and Analysis. Mar 1994. 111p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission Information Digest (digest) provides a summary of information about the US Nuclear Regulatory Commission (NRC), NRCs regulatory responsibility the activities NRC licenses, and general information on domestic and worldwide nuclear energy. The digest, published annually, is a compilation of nuclear-and NRC-related data and is designed to provide a quick reference to major facts about the agency and the industry it regulates. In general, the data cover 1975 through 1993, with exceptions noted. Information on generating capacity and average capacity factor for operating US commercial nuclear power reactors is obtained from monthly operating reports that are submitted directly to the NRC by the information is reviewed by the NRC for consistency only and no independent validation and/or verification is performed.

2108 Economics

Refer also to citation(s) 20828, 21341

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 20844, 21327, 21342, 21405, 21409, 21419, 21503, 21512, 21554, 21566, 21578, 23288, 23289, 23290, 23300, 23301

21341 (ANL/RA/CP–80550) **An overview of the current status of resonance theory in reactor physics applications.** Hwang, R.N. Argonne National Lab., IL (United States). [1993]. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9310313–1: 10. international school of nuclear physics, neutron physics, and nuclear energy, Varner (Bulgaria), 3-11 Oct 1993). Order Number DE94010465. Source: OSTI; NTIS; INIS; GPO Dep.

The neutron resonance phenomena constitute one of the most fundamental subjects in nuclear physics as well as in reactor physics. It is the area where the concepts of nuclear interaction and the treatment of the neutronic balance in reactor lattices become intertwined. The later requires the detailed knowledge of resonance structures of many nuclide of practical interest to the development of nuclear energy. The key issue of the resonance treatment in reactor applications is directly associated with the use of the microscopic cross sections in the macroscopic reactor cells with a wide range of composition, temperature,and geometric configurations. It gives rise to the so called self-shielding effect. The accurate estimations of such a effect is essential not only in the calculation of the criticality of a reactor but also from the point of view of safety considerations. The latter manifests through the Doppler effect particularly crucial to the fast reactor development. The task of accurate treatment of the self-shielding effect, however, is by no means simple. In fact, it is perhaps the most complicated problem in neutron physics which, strictly speaking, requires the dependence of many physical variables. Two important elements of particular interest are : (1) a concise description of the resonance cross sections as a function of energy and temperature; (2) accurate estimation of the corresponding neutron flux where appropriate. These topics will be discussed from both the historical as well as the state-of-art perspectives.

21342 (DOE/FTR–94008421) **Travel to Israel for Conference on Reactor Physics and Reactor Computation: Foreign trip report, January 20–29, 1994.** Motes, B.G. EG and G Idaho, Inc., Idaho Falls, ID (United States). 4 Mar 1994. 19p. Sponsored by Department of Defense, Washington, DC (United States). DOE

Contract AC07-76ID01570. Order Number DE94008421. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Presented is the attendee's trip report for attendance of the International Conference on Reactor Physics and Reactor Computation in Tel Aviv, Israel between September 20–24, 1993. The purpose of attending the conference was to obtain through formal presentations and discussions current information related to ongoing nuclear fuel cycle activities in other countries.

2202 Components and Accessories

Refer also to citation(s) 21317, 21427, 21498, 21525, 21526, 21538, 21575, 21592, 21642, 21648, 21649, 21650, 22012, 23284, 23296, 23298, 23303

21343 (HW–58143) **Corrosion test of irradiated uranium in monoisopropylbiphenyl (RM-171).** Brandt, R.L. Pacific Northwest Lab., Richland, WA (United States). 11 Nov 1958. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013679. Source: OSTI; NTIS; GPO Dep.

The use of organic cooling media for nuclear reactors operating at high power levels predicates the use of a coolant which will not react violently with metallic uranium in the event of a fuel element failure. This report describes the testing, and subsequent examination, of two pieces of irradiated uranium which were immersed in monoisopropylbiphenyl (MIPB) at high temperatures and pressures for periods of time up to twenty-five days. The uranium samples had different irradiation histories and cooling times. Similar experiments had been performed with unirradiated uranium by the Corrosion and Coatings Operation, and it was wished to determine whether irradiated uranium would react with MIPB in a different manner.

21344 (INIS-JP–018, pp. 1565-1571) **Pathfinder decommissioning: Reactor vessel packaging and transportation.** Closs, J.W. (Northern States Power Co., Minneapolis, MN (United States)). 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

This paper discusses background material related to Pathfinder decommissioning, and emphasizes the packaging and transportation of the decommissioned Pathfinder reactor vessel. (J.P.N.).

21345 (NUREG/CP–0135) **Workshop on environmental qualification of electric equipment.** Lofaro, R. (Brookhaven National Lab., Upton, NY (United States)); Gunther, W.; Villaran, M.; Lee, B.S.; Taylor, J. (comps.). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). May 1994. 306p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52409; CONF-9311207–: Workshop on environmental qualification of electric equipment, Rockville, MD (United States), 15-16 Nov 1993). Source: OSTI; NTIS; INIS; GPO.

Questions concerning the Environmental Qualification (EQ) of electrical equipment used in commercial nuclear power plants have recently become the subject of significant interest to the US Nuclear Regulatory Commission (NRC). Initial questions centered on whether compliance with the EQ requirements for older plants were adequate to support plant operation beyond 40 years. After subsequent investigation, the NRC Staff concluded that questions related to the differences in EQ requirements between older and newer plants constitute a potential generic issue which should be evaluated for backfit, independent of license renewal activities. EQ testing of electric cables was performed by Sandia National Laboratories (SNL) under contract to the NRC in support of license renewal activities. Results showed that some of the environmentally qualified cables either failed or exhibited marginal insulation resistance after a simulated plant life of 20 years during accident simulation. This indicated that the EQ process for some electric cables may be non-conservative. These results raised questions regarding the EQ process including the bases for conclusions about the qualified life of components based upon artificial aging prior to testing.

21346 (NUREG/CR–6095) **Aging, Loss-of-Coolant Accident (LOCA), and high potential testing of damaged cables.** Vigil, R.A. (Science & Engineering Associates, Inc., Albuquerque, NM (United States)); Jacobus, M.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Controls and Human Factors; Sandia National Labs., Albuquerque, NM (United States); Science and Engineering Associates, Inc., Albuquerque, NM (United States). Apr 1994. 69p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-94AL85000. (SAND–93-1803). Source: OSTI; NTIS; INIS; GPO.

Experiments were conducted to assess the effects of high potential testing of cables and to assess the survivability of aged and damaged cables under Loss-of-Coolant Accident (LOCA) conditions. High potential testing at 240 Vdc/mil on undamaged cables suggested that no damage was incurred on the selected virgin cables. During aging and LOCA testing, Okonite ethylene propylene rubber (EPR) cables with a bonded jacket experienced unexpected failures. The failures appear to be primarily related to the level of thermal aging and the presence of a bonded jacket that ages more rapidly than the insulation. For Brand Rex crosslinked polyolefin (XLPO) cables, the results suggest that 7 mils of insulation remaining should give the cables a high probability of surviving accident exposure following aging. The voltage necessary to detect when 7 mils of insulation remain on unaged Brand Rex cables is approximately 35 kVdc. This voltage level would almost certainly be unacceptable to a utility for use as a damage assessment tool. However, additional tests indicated that a 35 kvdc voltage application would not damage virgin Brand Rex cables when tested in water. Although two damaged Rockbestos silicone rubber cables also failed during the accident test, no correlation between failures and level of damage was apparent.

21347 (WSRC-MS–93-619) **Welding irradiated stainless steel.** Kanne, W.R. Jr.; Chandler, G.T.; Nelson, D.Z.; Franco-Ferreira, E.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940657–1: 17. symposium on effects of radiation on materials, Sun Valley, ID (United States), 20-23 Jun 1994). Order Number DE94013661. Source: OSTI; NTIS; INIS; GPO Dep.

Conventional welding processes produced severe underbead cracking in irradiated stainless steel containing 1 to 33 appm helium from n,a reactions. A shallow penetration overlay technique was successfully demonstrated for welding irradiated stainless steel. The technique was applied to irradiated 304 stainless steel that contained 10 appm helium. Surface cracking, present in conventional welds made on the same steel at the same and lower helium concentrations, was eliminated. Underbead cracking was minimal compared to conventional welding methods. However, cracking in the irradiated material was greater than in tritium charged and aged material at the same helium concentrations. The overlay technique provides a potential method for repair or modification of irradiated reactor materials.

2203 Fuel Elements

Refer also to citation(s) 20798, 20806, 21322, 21379, 21380, 21382, 21394, 21395, 21396, 21397, 21415, 21416, 21418, 21422, 21425, 21432, 21451, 21452, 21453, 21456, 21458, 21461, 21463, 21467, 21468, 21488, 21489, 21490, 21496, 21499, 21501, 21505, 21515, 21516, 21518, 21530, 21533, 21535, 21539, 21545, 21548, 21556, 21561, 21565, 21591, 23292, 23293, 23296

21348 (HW–7-5413) **Summary of blistering inspections.** Woods, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Nov 1946. 4p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012960. Source: OSTI; NTIS; GPO Dep.

Declassified.

A table summarizes all the information on blistered slugs from March 1946 to Oct. 12, 1946, as recorded in weekly technical progress letters.

21349 (HW–57692) **Evaluation of vacuum-canned and hot-press fuel elements PT IP-44A and IP-45A.** Smith, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1958. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012020. Source: OSTI; NTIS; GPO Dep.

Declassified.

As new designs, geometries, and procedures for fabricating experimental fuel elements are developed, it becomes necessary to determine how well each new product fills the need which prompted its development. While the criteria for satisfactoriness vary with the type of fuel element, there is one criterion that is common to all types designed for use in heterogeneous reactors: the elements must withstand irradiation in the reactor for the required period without jacket rupture or excessive change in dimensions. To learn whether a new type of element meets this and other requirements, a statistically significant number of representative samples must be subjected to, first, comprehensive screening tests designed to insure trouble-free performance in the reactor; next, a long-term irradiation exposure equivalent to or exceeding that which will be normal for that type of element; and finally, a thorough examination to determine the extent of quality loss resulting from the irradiation. This report discusses the application of the foregoing philosophy in the evaluation of two lots of experimental fuel elements fabricated by unconventional procedures.

21350 (HW–60754) **Radiometallurgical examination of PT-IP-221-A measurement of flow channel temperature in 7 rod cluster fuel element (RM-287).** Teats, R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Jun 1959. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012700. Source: OSTI; NTIS; GPO Dep.

Declassified.

Eight Zircaloy-2 jacketed, natural uranium seven-rod cluster elements were irradiated in a KER loop to determine flow channel temperature characteristics. One of the elements, which had 200 MWD/T exposure, was sent to the Radiometallurgy Laboratory for examination in April 1959. An outside rod of the cluster was sectioned and examined metallographically. No cracks or flaws were observed in the uranium cladding or bonding.

21351 (HW–61784) **KER Loop I operating report – A report on the irradiation of zircaloy-2 jacketed tube-and-tube elements in KER Loop I.** Eikum, L.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Sep 1959. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013496. Source: OSTI; NTIS; GPO Dep.

The objective of this test was to determine the in-reactor performance of co-extruded Zr-2 jacketed tube-and-tube elements. The effect of power, surface temperature, and uranium alloying on dimensional stability and uranium swelling and cracking was to be measured. The charge consisted of two unalloyed tube-and-tube elements, which were Zr-2 jacketed and were 36 inches in length. The rest of the charge consisted of spacer material and coupon holders. The test started on 6-29-59 and ran for a period of 32 days. On 7-30-59, the delayed neutron monitor reading and loop activities increased to a point that required reactor shutdown scram. The reactor was shut down, and the fuel elements were discharged. Loop water samples were analyzed for fission products. Evidence was found of high activity of Iodine isotopes of very short half-life. There was also some indication of other fission products. Visual inspection of the fuel elements after discharge disclosed small wrinkles on the jacket surface of the two unalloyed elements.

21352 (HW–65800) **Cap-spire pulsing.** Burgess, C.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jun 1960. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011294. Source: OSTI; NTIS; GPO Dep.

Declassified.

The cap-spire pulsing technique of preheating the cap-spire portion of the fuel assembly does significantly improve the brazing of the cap-spire assembly. The air pocket at the spire wafer junction is fully removed. The cap side wafer is essentially 100% wetted with brazing alloy. Destructive tests show that a 4 to 1 improvement in most quality measurements is achieved over present cap preheating techniques, without using additional cleaning step of spire etching. The pulsing is accomplished by a cammed drive system, using a stroke of three-fourths of an inch with a spring return. The system is driven by an electrical gear reduction motor at a rate of 1.4 pulses per second. A preheating cycle of 21 $\pm$ 2 seconds is used for the current I&E cap designs. The cap-spire assembly does not require any special treatment other than the normal chemical cleaning.

21353 (HW–70828) **The preparation and irradiation behavior of chemically-nickel plated aluminum-jacketed fuel elements.** Jacky, G.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Sep 1961. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012025. Source: OSTI; NTIS; GPO Dep.

Declassified.

Nickel plated aluminum was considered as a jacketing material for nuclear fuel elements as early as 1954, and both static and dynamic corrosion tests were carried out by Argonne National Laboratories and by Atomic Energy of Canada Ltd., employing demineralized water at temperatures of from 260 to 316°C. Results generally indicated that the nickel had excellent corrosion resistance; however, difficulties were experienced in achieving satisfactory continuity and adhesion of the plate; subsequent work emphasized Ni-Aluminum alloy development. At Hanford, our earliest experience employed Ni plate on aluminum-jacketed fuel elements primarily to minimize mechanical damage to the jacket surface during an irradiation test. The appearance of these fuel elements after discharge suggested that the nickel plate might also be a highly satisfactory coating for corrosion and abrasion resistance. Incentives were manifold, including reducing the incidence of in-reactor fuel element failures and permitting reduction of the aluminum jacket thickness with a concomitant increase in space available for uranium or for cooling water passage. A program has been carried out for the past three years aimed at determining various methods of employing nickel plated aluminum jacket material and testing the capabilities of high quality commercially adequate plate. Almost exclusively chemically deposited plate has been tested, primarily because of the excellent plate-thickness control inherent in the process compared to electrodepositon.

21354 (HW–72347) **Quarterly progress report fuels development operation, January, February, March 1962.** Cadwell, J.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Apr 1962. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012026. Source: OSTI; NTIS; GPO Dep.

Declassified.

The report is divided into the following sections: physical metallurgy, metallic fuels development, fabrication development, fuel evaluation, and plutonium recycle program.

21355 (HW–73195) **Progress report for the projection welded brazed closure.** Vancott, L.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Apr 1962. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011980. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report covers progress on the Projection Welded Brazed Closure following work of Ard and Steinkamp (HW-69592). In order to continue the investigation of the closure on NPR inner fuel, a 600 KVA machine was acquired. Weld tests were conducted; the heat balance problem was addressed.

21356 (HW–76214) **Post-irradiation data on fuel elements from KER Loop 4.** Bennett, E.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Jan 1963. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010865. Source: OSTI; NTIS; GPO Dep.

Declassified.

Fourteen NAE1 fuel elements were discharged from KER Loop-4, after irradiation to an average exposure of 1250 MWD, at prototype N-Reactor coolant temperature and pressure. The elements were disassembled and measured in the KE fuel examination facility. This report includes all measurements, except the profilometer data.

21357 (HW–78777) **Feasibility of the use of induction heating equipment for Pilot Plant development work.** Powers, H.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Aug 1963. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010568. Source: OSTI; NTIS; GPO Dep.

Declassified.

Procurement and installation are proposed of a 50-kW, high-frequency induction heating unit for can-sleeve preheating prior to dip brazing to the uranium core.

21358 (HW–80800) **Proposed test for using AlSi made from 8001 scrap.** Weakley, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Feb 1964. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010637. Source: OSTI; NTIS; GPO Dep.

Declassified.

A 40-day uranium core canning test (10,000 lbs of high nickel AlSi) is proposed in which one canning line has only AlSi of 0.78-1.1 % Ni added as makeup; the other canning lines would be operated as usual. Besides monitoring the Ni content and other impurities in the test and control lines, attributes, variables, and destructive fuel element data would be collected and analyzed. Estimates for annual savings are given for 8, 9, and 10-line shifts per day.

21359 (INIS-JP–018, pp. 1552-1556) **Burnup verification measurements for spent nuclear fuel.** Ewing, R.I. (Sandia National Lab., Albuquerque, NM (United States)). 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The number of shipments of spent fuel could potentially be reduced by about one-half by the use of burnup credit casks, considerably enhancing public and occupational safety, and reducing costs. Radiation measurements can be used in burnup credit operations to help prevent misloading of fuel that does not meet the minimum specifications for a particular cask design. Neutron and gamma-ray yield measurements are proposed as a means of qualifying spent fuel assemblies. Plans are under way to evaluate the FORK measurement system at utility spent fuel storage pools. (J.P.N.).

21360 (JAERI-M–93-244) **Development of a shielded pellet thermal conductivity measurement apparatus.** Owada, Isao (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Nishino, Yasuharu; Kushida, Teruo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 103p. (In Japanese). Order Number DE94770641. Source: OSTI; NTIS; INIS.

At the Hot Engineering Division, development of new PIE techniques for the study on high burnup fuel behavior have been continued. The thermal conductivity in high burnup fuel pellet is one of the most important thermophysical properties. The shielded pellet thermal conductivity apparatus using the laser flash method was developed and it became possible to calculate the thermal conductivity of high burnup fuel pellets. This report describes the results of measurement of the thermal diffusivity of the metallic tantalum and ceramic samples such as alumina, zirconia and mullite, at room temperature to 1800degC. The measured value of the thermal diffusivity with tantalum were correspond to the data of the TPRC data series published by the Purdue University in USA. The thermal diffusivity of the fan shaped tantalum samples was also measured to examine the effect of sample shape. The result of data analysis by the logarithmic method showed small difference between round and fan shaped samples. The measured value of ceramic samples were similar scatter in tantalum one. (author).

2204 Control Systems

Refer also to citation(s) 21431, 21507

21361 (CNIC–00760) **Verification and validation of the safety parameter display system for nuclear power plant.** Zhang Yuanfang (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology). China Nuclear Information Centre, Beijing, BJ (China). May 1993. 12p. (TSHUNE–0069.). Order Number DE94626310. Source: OSTI; NTIS (US Sales Only); INIS.

During the design and development phase of the safety parameter display system for nuclear power plant, a verification and validation (V and V) plan has been implemented to improve the quality of system design. The V and V activities are briefly introduced, which were executed in four stages of feasibility research, system design, code development and system integration and regulation. The evaluation plan and the process of implementation as well as the evaluation conclusion of the final technical validation for this system are also presented in detail.

21362 (HW–7-5519) **100 Areas technical activities report – Physics, November 1946.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Dec 1946. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013501. Source: OSTI; NTIS; GPO Dep.

This report divides the activities for November into three sections: D Pile; F Pile; and general physics. During November the D Pile was down twice for regularly scheduled shutdowns. Two scram occurred during the month, both of short duration. Five Special Request 15 tubes were discharged and recharged with Special Request 15. Some 13 inhour of reactivity were gained during the month. Vertical rod thimbles, 10 through 22, were tested. A Production Test was performed to determine the reactivity power coefficients of the F Pile at low power levels and with practically no xenon poison remaining. Additional experience in the use of temporary poison columns during an extended shutdown of the pile was obtained during the month. Four new bismuth columns were charged during the month and six tubes were charged with LiF. The F Pile had not yet returned to xenon equilibrium following the shutdown of November 27 at the end of the month, but conditions just prior to this shutdown indicate a loss of one inhour since October 31. Two sets of specimens were removed from the "B" Test Hole of the F Pile on November 4. Samples were also machined from graphite removed from the No. 9 thimble of the D pile. Results from studies on these samples are given.

21363 (HW–7-6253) **Determination of reactivity coefficients and rod calibration of D Pile: interim report on Production Test No. 105-97-P.** Kruesi, F.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 25 Apr 1947. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013511. Source: OSTI; NTIS; GPO Dep.

The test of March 7, 1947 was planned as a check on power coefficient values; however, an analysis of reactivity data gave evidence of a considerable flattening of "A" rod in the region between 0–75 inches out. A second test of longer duration was therefore made on April 1, 1947 in order to obtain a check calibration of this portion of the control rod. The results of this test verified the flattening of this portion of "A" rod. The redetermined power coefficients based on new rod calibrations are given.

21364 (HW–13022) **100 Areas technical activities report – Physics, February 1949.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Mar 1949. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013512. Source: OSTI; NTIS; GPO Dep.

Activities for the month of February are as follows: (1) calculations of reactivity and temperature limits; (2) calculations of operating levels of D pile if reduced in size; (3) symposium on power coefficients; (4) test of new vertical (safety) rods; (4) metal quality studies; (5) status of process tube ionization chamber failures; (6) reactivity balance of each of operating piles; (7) graphite testing; (8) water activity calculations; (9) pile shielding; (10) radioactivity of titanium; and (11) critical mass experiments.

21365 (HW–13027) **100 Areas technical activities report – Physics, January 1949.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Feb 1949. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013513. Source: OSTI; NTIS; GPO Dep.

Activities covered in this report for the month of January are as follows: (1) power coefficient test of the F Pile; (2) control rod calibration; (3) investigations into reactivity gains possible by zoning the pile for metal charging; (4) polonium production under emergency conditions: (5) analysis of process tube ion chamber failures; (6) measurements of the thermal neutron flux in various pockets of the E Test Hole of the F Pile; (7) reactivity balance of each of the operating piles at beginning and end of this report period; (8) graphite studies; (9) pile shielding; (10) radiation measurements on a simulated D-R rod guide and rod; and (11) calculation of radioactive isotopes expected in cooling water.

21366 (HW–15153) **100 Areas technical activities report – Physics, October 1949.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Nov 1949. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013503. Source: OSTI; NTIS; GPO Dep.

This report contains brief summaries of activities at the Hanford production reactors for the month of Oct. The activities for the Pile Physics Group are: (1) H Area start-up; (2) outlet temperature recording systems; (3) reactivity balance for each pile for this period. Activities for the Experimental Physics Group are: (1) graphite testing; (2) 305 testing – P-slug standardization and graphite standards; (3) shielding. Also status is given on critical mass project.

21367 (HW–58408) **Summary of information for U.K. – Information request on gamma flux monitor.** Nilson, R.; Dunbar, A.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Dec 1958. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013515. Source: OSTI; NTIS; GPO Dep.

Declassified.

Summarized herein is the available information on the subject, "Reactor Gamma Flux Monitors." Apparently, a misunderstanding exists between the U.K. representatives and the related information presented by Dr. Nilson at the Argonne meeting July 24 and 25th. Dr. Nilson's reference at the US/UK meeting was to the use of gamma-compensated neutron detection chambers at Hanford. Such chambers have been designed and used in one old reactor for a short period as a prototype for a detector for the octant monitor system. No gamma compensated chambers are in any of the reactors at present. Under development is a neutron flux indicating system which will operate in the intermediate range (10^{-7} to 10^{-1} full power) and will use commercially available gamma compensated ion chambers. These will be used to provide signals for reactor period meters. At Hanford there has been no operating experience with gamma flux monitors as such or with extensive in core neutron flux monitors. Characteristics of systems under development are given for information as well as current information on the octant system.

21368 (HW–66750) **Temperature-level indicator at console.** Lockwood, E.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Sep 1960. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011096. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/ reactor instrumentation; CONTROL ROOMS; DISPLAY DEVICES; TEMPERATURE MONITORING; POWER DISTRIBUTION; REACTOR START-UP

21369 (HW–70215) **Summary of the operational status of reactor control instrumentation, Report No. 2.** Stewart, S.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Jul 1961. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010871. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this review is to report the operability status of the reactor control instrumentation. The status of the instruments was determined twice during the first six months of this year, April 1 and June 1. The information contained in this report is not intended to be a complete description of the control instruments, but only as they apply to reactor control. The assigned Pile Physicist at each reactor reported the status of instrumentation at his reactor. Chart I summarizes the operability status of the various instruments. Chart II shows the relative range of reactor power over which these control instruments apply. Appendix II contains a functional description of the instruments and Appendix III lists how each instrument is used during reactor operation.

21370 (HW–78733-RD2) **Analysis and evaluation of the N Reactor Zone Temperature Monitoring System.** Philipp, L.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Nov 1963. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010545. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document reports the result of an engineering analysis and evaluation of the Zone Temperature Monitoring System. The main function of the system is to protect the reactor from localized increases in reactor power which would be reflected by increases in the tube outlet temperatures in the affected zones of the reactor. This function has been implemented by the installation of immersion temperature detectors on 109 representative process tubes. The signals from the detectors will be monitored and will automatically annunciate, initiate a power setback, or initiate a reactor scram should the outlet temperature of one, two, or three tubes exceed an adjustable, preset limit.

21371 (HW–84086) **105-F intermediate range test hole parameters.** Erickson, G.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Nov 1964. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010857. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report discusses 105 intermediate range test hole which was bored in 105-F to demonstrate reactor hole boring techniques. This test hole was then utilized to determine the performance of neutron sensitive gamma compensated ion chambers (CIC), the effectiveness of epoxy reactor shield plug designs, the compatability of the prototype.components intermediate range instrumentation, and demonstrate the performance of an intermediate range monitor system on a typical Hanford reactor application. In the process of determining the above information physical, nuclear, gamma, and temperature data was recorded as related to the 105-F intermediate range monitor test hole and is provided in this report.

21372 (NUREG/CR–5941) **Technical basis for evaluating electromagnetic and radio-frequency interference in safety-related I&C systems.** Ewing, P.D. (Oak Ridge National Lab., TN (United States)); Korsah, K. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Apr 1994. 33p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States).

DOE Contract AC05-84OR21400. (ORNL/TM–12221). Source: OSTI; NTIS; INIS; GPO.

This report discusses the development of the technical basis for the control of upsets and malfunctions in safety-related instrumentation and control (I&C) systems caused by electromagnetic and radio-frequency interference (EMI/RFI) and power surges. The research was performed at the Oak Ridge National Laboratory (ORNL) and was sponsored by the USNRC Office of Nuclear Regulatory Research (RES). The motivation for research stems from the safety-related issues that need to be addressed with the application of advanced I&C systems to nuclear power plants. Development of the technical basis centered around establishing good engineering practices to ensure that sufficient levels of electromagnetic compatibility (EMC) are maintained between the nuclear power plant's electronic and electromechanical systems known to be the source(s) of EMI/RFI and power surges. First, good EMC design and installation practices need to be established to control the impact of interference sources on nearby circuits and systems. These EMC good practices include circuit layouts, terminations, filtering, grounding, bonding, shielding, and adequate physical separation. Second, an EMI/RFI test and evaluation program needs to be established to outline the tests to be performed, the associated test methods to be followed, and carefully formulated acceptance criteria based on the intended environment to ensure that the circuit or system under test meets the recommended guidelines. Third, a program needs to be developed to perform confirmatory tests and evaluate the surge withstand capability (SWC) and of I&C equipment connected to or installed in the vicinity of power circuits within the nuclear power plant. By following these three steps, the design and operability of safety-related I&C systems against EMI/RFI and power surges can be evaluated, acceptance criteria can be developed, and appropriate regulatory guidance can be provided.

21373 (WHC-SA–2420) **Operator awareness of system status during Fast Flux Test Facility transition to standby.** Gibson, J.L. Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9405138–1: 1994 Department of Energy configuration management workshop, Las Vegas, NV (United States), 3 May 1994). Order Number DE94010789. Source: OSTI; NTIS; INIS; GPO Dep.

A facility in transition, due to a change in its mission or its operating status, begins to depart from a previously well-defined normal mode of operation. The equipment becomes reconfigured or deactivated. In an environment of transition, the Fast Flux Test Facility (FFTF) has employed methods to enhance operator awareness of system status. These methods are described in this report.

2205 Environmental Aspects

Refer also to citation(s) 20938, 21605, 21646, 22618, 22725, 23292, 23293, 23294

21374 (ENEA-RT-DISP–92-03) **Analysis of world major regulatory guides for NPP seismic design: Guideline for high risk facilities.** Serva, L. (ENEA, Rome (Italy). Direzione Sicurezza Nazionale e Protezione Sanitaria). ENEA, Rome (Italy). Direzione Sicurezza Nazionale e Protezione Sanitaria. Jun 1993. 44p. (RT/DISP–92-03). Order Number DE94775300. Source: OSTI; NTIS (US Sales Only).

This paper analyzes rules for siting and designing nuclear power plants (NPPs) in various countries with both interplate and intraplate geological characteristics. Those characteristics lead to very different approaches to the solution of the problem. However, all the described rules bestow a key role on seismo-tectonics in the choice of the suitable site and in the reference earthquake evaluation. In particular, all the rules, more or less explicitly, recommend the exclusion of sites potentially affected by surface faulting. As for the reference earthquake, the seismo-tectonic analysis of the region where the site lies is essential in both deterministic and probabilistic assessments. It's very important to point out that, in all the guides, the professional judgment of the experts is significant for the evaluation. Guide quality depends on the professionality of the expert but, even more, on the reliability of the data-base. It's therefore recommended that maximum effort should be spent in the accuracy and completeness of such data-bases, especially with regard to the more significant data.

21375 (HW–75045) **Calculated fission product release from PRTR rupture.** Stoddard, J.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Sep 1962. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007327. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Approximately 15 minutes after shutdown on August 21, 1962, evidence of a rupture was observed in the form of high radiation levels in the containment vessel and rupture monitor indications. Discharge of a special MgO-PuO_2 test element revealed a cladding break of about 1.5 inches in length and about 1/4 inch wide in the widest place, located 36 inches from the top of the fuel element as it would have been oriented in the reactor. A visual examination in Radiometallurgy revealed that approximately 9.25 inches of fuel material or about 0.55% of the entire fuel element had escaped. The quantity of fission products released from the rupture is presented, and the quantities and radiation levels from the individual fission product isotopes are calculated and presented.

21376 (KFK–4333) **COSYMA. Dose models and countermeasures for external exposure and inhalation.** Hasemann, I.; Ehrhardt, J. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Jan 1994. 169p. Contract CEC FI3P-CT92-0057. Order Number DE94773753. Source: OSTI; NTIS (US Sales Only); INIS.

As one of the main objectives of the MARIA project ("Methods for Assessing the Radiological Impact of Accidents") initiated by the program package COSYMA (COde SYstem from MAria") for assessing the radiological and economic off-site consequences of accidental releases of radioactive material to the atmosphere has been jointly developed by the KfK, and the NRPB. COSYMA includes models and data for assessing a broad spectrum of accident consequences, and they are implemented in independent modules. The subject are those modules, which incorporate models and data for assessing individual and collective organ doses via external and internal exposure pathways and for quantifying the extent and duration of countermeasures including their dose mitigating effect. The flexible countermeasure modelling offers considerable freedom in specifying a wide range of emergency actions and criteria, what allows for consideration of most of the ntaional regulations in the different European countries. (orig./HP)

21377 (KFK–5259) **Content and functions of the pilot version 1 of RODOS/RESY.** Benz, G.; Ehrhardt, J.; Faude, D.; Fischer, F.; Paesler-Sauer, J.; Rafat, M.; Schichtel, T.; Schuele, O.; Steinhauer, C. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Jan 1994. 81p. (In German). Sponsored by Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany);Commission of the European Communities, Brussels (Belgium). Contract BMU St.Sch. 1054/1; Contract CEC FI3P-CT92-0036. Order Number DE94773751. Source: OSTI; NTIS (US Sales Only); INIS.

RODOS/RESY is an integrated real-time on-line decision support system for external emergency management after nuclear accidents. It is part of the comprehensive RODOS-system (real-time on-line decision support), which is designed for use in Europe after accidental releases of radioactive material to the atmosphere and hydrosphere. RODOS/RESY is limited in its applicability to the near range of nuclear facilities and the early phase of an accident with airborne radioactive releases. Therefore, it serves directly as a decision-aiding tool for countermeasure actions in the responsibility of local emergency management authorities. At present, RODOS is and RandD project which aims at the further development for operational use of the first prototype version completed in autumn 1992. A first step towards this goal will be the pilot version 1 of RODOS/RESY, which bill be ready by the end of 1994 for coupling to monitoring networks of nuclear reactor remote control surveillance systems and pre-operational use. The report describes the structure, content and functions of this pilot version. (orig.)

21378 (NUREG–1488) **Revised Livermore seismic hazard estimates for sixty-nine nuclear power plant sites east of the Rocky Mountains: Final report, July 1993–March 1994.** Sobel, P. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering. Apr 1994. 93p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The draft version of this report presented updated Lawrence Livermore National Laboratory (LLNL) probabilistic seismic hazard analysis estimates for 69 nuclear power plant sites in the region of the United States east of the Rocky Mountains. LLNL performed a re-elicitation of seismicity and ground motion experts to improve their estimates of uncertainty in seismicity parameters and ground motion models. Using these revised inputs, LLNL updated the seismic hazard estimates documented in NUREG/CR-5250 (1989). These updated hazard estimates will be used in future NRC actions. The draft was issued for public comment in October 1993. By the end of the public comment period, February 28, 1994, comments had been received from two nuclear industry companies. The comments from these companies neither contested nor suggested amendments to the technical data conveyed in the report. Rather, they both suggest changes in the Individual Plant External Event Examination (IPEEE) program scope. This report is not the forum for discussion of the IPEEE program. Possible modification to the scope of the IPEEE will be examined in its own setting. Therefore, there are no technical differences between the draft report and this final report. Any information as to modifications to the IPEEE program will be provided to the public via an NRC general communication.

21379 (WSRC-MS–94-0245) **Seismic Record Processing Program (SRP), Version 1.03.** Karabalis, D.L. (South Carolina Univ., Columbia, SC (United States). Coll. of Engineering); Cokkinides, G.J.; Rizos, D.C. Westinghouse Savannah River Co., Aiken, SC (United States); South Carolina Univ., Columbia, SC (United States). Coll. of Engineering. Apr 1992. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013664. Source: OSTI; NTIS; INIS; GPO Dep.

The Seismic Record Processing Program (SRP) is an interactive computer code developed for the calculation of artificial earthquake records that comply with the US Nuclear Regulatory Commission Standard Review Plan. The basic objective of SRP is the calculation of artificial seismic time histories that correspond to Design Response Spectra specified in the US Atomic Energy Commission Regulatory Guide 1.60 and/or the Power Spectral Density (PSD) requirements of the NRC Standard Review Plan. However, SRP is a general computer code and can accommodate any arbitrarily specified Target Response Spectra (TRS) or PSD requirements. In addition, among its other futures, SRP performs quadratic baseline correction and calculates correlations factors for a set of up to three earthquake records. This manual is prepared in two parts. The first part describes the methodologies and criteria used while the second is a user's manual. In section 1 of the first part, the techniques used for the adjustment of a given earthquake record to a required TRS family of curves for a set of specified damping ratios are presented. Similarly, in section 2 of the first part, the PSD of an earthquake record is compared to a target PSD and adjusted accordingly. Sections 3 and 4 of the first part deal with the subjects of baseline correction and correlation of earthquake records, respectively. The second part is the user's manual. The user's manual contains a list of the computer hardware requirements, instructions for the program installation, a description of the user generated input files, and a description of all the program menus and commands.

2206 Research, Test, Training, Production, Irradiation, Materials Testing Reactors

Refer also to citation(s) 20812, 20825, 21043, 21347, 21349, 21351, 21353, 21354, 21355, 21357, 21361, 21362, 21363, 21364, 21365, 21366, 21367, 21368, 21369, 21370, 21374, 21591, 21599, 21602, 21603, 21604, 21605, 21606, 21607, 21608, 21651, 21652, 2 654, 21656, 21657, 21658, 21659, 21660, 21661, 21662, 21663, 21990

21380 (ANL/RERTR/TM–19) **Reduced enrichment for research and test reactors: Proceedings.** Argonne National Lab., IL (United States). Jul 1993. 376p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209266–: 1992 international meeting on reduced enrichment for research and test reactors, Roskilde (Denmark), 27 Sep - 1 oct 1992). Order Number DE94012405. Source: OSTI; NTIS; INIS; GPO Dep.

The 15th annual Reduced Enrichment for Research and Test Reactors (RERTR) international meeting was organized by Ris≤ National Laboratory in cooperation with the International Atomic Energy Agency and Argonne National Laboratory. The topics of the meeting were the following: National Programs, Fuel Fabrication, Licensing Aspects, States of Conversion, Fuel Testing, and Fuel Cycle. Individual papers have been cataloged separately.

21381 (ANL/TD/CP–82760) **Using low-enriched uranium in research reactors: The RERTR program.** Travelli, A. Argonne National Lab., IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9404154–1: Conference on peaceful uses of nuclear energy and nonproliferation, Bariloche (Argentina), 19-21 Apr 1994). Order Number DE94011507. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of the RERTR program is to minimize and eventually eliminate use of highway enriched uranium (HEU) in research and test reactors. The program has been very successful, and has developed low-enriched uranium (LEU) fuel materials and designs which can be used effectively in approximately 90 percent of the research and test reactors which used HEU when the program began. This progress would not have been possible without active international cooperation among fuel developers, commercial vendors, and reactor operators. The new tasks which the RERTR program is undertaking at this time include development of new and better fuels that will allow use of LEU fuels in all research and test reactors; cooperation with Russian laboratories, which will make it possible to minimize and eventually eliminate use of HEU in research reactors throughout the world, irrespective of its origin; and development of an LEU-based process for the production of ^{99}Mo. Continuation and intensification of international cooperation are essential to the achievement of the ultimate goals of the RERTR program.

21382 (BNCC–55) **Preliminary analysis of K-Reactor downcomer approach section pressures during temperature transients.** Rowe, D.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Mar 1965. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012859. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to present a preliminary analysis of pressures in the K-Reactor downcomer approach section during bulk outlet water temperature transients.

21383 (BNWC–72) **Hanford contribution for the twentieth high temperature fuels committee meeting, May 18–20, 1965: NMPO, Cincinnati, Ohio.** Last, G.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Apr 1965. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012858. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details post-irradiation annealing studies at 610 and 630 C which have shown that a submicron dispersion of UC in uranium is effective in reducing mobility of fission gases in uranium irradiated to 1.4 $\times$ 10^{20} fissions/cc (0.3 percent burnup). Electron microscopy of both the as-irradiated and the annealed samples show that a large population of less than 0.1μ UC particles develops which is believed to be responsible for the decreased swelling during annealing. Uranium fuel elements containing 390 ppm Fe and 840 ppm aluminum shows substantially less swelling both during irradiation and during post-irradiation annealing than uranium

containing 140 ppm Fe and 120 ppm Si. Zircaloy-2 clad thorium-uranium fuel continues to show excellent performance in a pressurized water loop. Fuel swelling is currently 1.0 percent at an exposure of 3.7×10^{20} fissions/cc (11,000 MWD/T).

21384 (BNWL–320) **Pacific Northwest Laboratory monthly activities report, August 1966.** Paul, R.S. Pacific Northwest Lab., Richland, WA (United States). Sep 1966. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012950. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document reports on: direct AEC sponsored programs (mainly Columbia River studies and exposure mechanisms), assistance to Douglas United Nuclear (production reactors), assistance to General Electric N-Reactor department, assistance to Isochem (processing), assistance to Hanford occupational health foundation, and technical assistance to Hanford Plant (environment, dosimetry).

21385 (BNWL–646) **Pacific Northwest Laboratory monthly activities report, November 1967.** Albaugh, F.W. Pacific Northwest Lab., Richland, WA (United States). Dec 1967. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012035. Source: OSTI; NTIS; GPO Dep.

Declassified.

Calculated temperatures permitted in the Columbia River under various suggested regulations were plotted and reported in support of AEC studies. Mechanisms of Environmental Exposure. Measurements of radioactivity were completed in 362 pupils and 5 teachers at Emerson School on November 17. Measurements will begin at the third Pasco elementary school on December 5. Lectures were given at Mark Twain School to the teaching staff on November 20, and to 23 classroom son November 27 through December 1. A lecture was also given to the PTA meeting the evening of November 20 at Robert Frost elementary school in Pasco. Modifications were made to the electronic equipment and to the mobile whole-body counter van to improve the performance of the facility to further protect the NaI crystal from potential cold weather damage. Errors found inn the computer-calculated environmental doses were being corrected at month's end, and the doses will be recalculated in December.

21386 (BNWL–696) **Pacific Northwest Laboratory monthly activities report, January 1968.** Albaugh, F.W. Pacific Northwest Lab., Richland, WA (United States). Feb 1968. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012039. Source: OSTI; NTIS; GPO Dep.

Declassified.

Analysis of Columbia River temperature trends indicates conformity with those previously reported. Despite unusually high average temperatures, the temperatures of the upper and lower extremes continued to converge on the mean. The construction of the John Day Dam is expected to have little temperature effect other than a delay of ten days in the timing of the annual temperature peak. Measurements of radioactivity in 465 children were completed at the third Pasco elementary school on January 12. Whole-body counting at the fourth school began on January 24, following lectures to the staff and 17 classrooms. The whole-body counter was recalibrated for K^{40} and Zn^{65} in late January. Only small modifications in the calibration factors over those currently employed are expected. Washington State Game Department personnel have supplied sufficient pheasant and quail samples shot near the Columbia River for comparison of radionuclide content between species and collection of these samples has been discontinued. The Department of Game continues to supply "road-kills" for radiochemical analysis in exchange for x-ray data on the number of birds which contain shot. A game-bird questionnaire for mailing to a statistical sample of Tri-City hunting license holders was drafted in January.

21387 (BNWL–721) **Pacific Northwest Laboratory monthly activities report, February 1968.** Albaugh, F.W. Pacific Northwest Lab., Richland, WA (United States). Mar 1968. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012037. Source: OSTI; NTIS; GPO Dep.

Declassified.

Measurements of radioactivity in 277 children were completed at the fourth Pasco Elementary School on February 16. Whole-body counting of children at the fifth elementary school began on February 21, following lectures to 12 classrooms in grades one through six. Analysis of pheasants, quail and chukar shot locally revealed that only birds collected in the vicinity of the Columbia River contained detectable P^{32} and Zn^{65}. In decreasing order of concentrations the three species ranked chukar > pheasant > quail. Heads of the birds consistently contained more of these two radionuclides than the edible flesh by factors varying up to 20. A ca5% sample of local hunters was drawn from Washington State Game Department records in February. A questionnaire designed to gather data on hunting and consumption of game birds by local residents will be mailed to these 657 people in March. The results will aid in defining the importance of game-bird consumption to local environmental radiation doses. Diet distributions of Richland and Benton City elementary school pupils were computed this month. Consumptions of various foods were determined for various age groups of boys and of girls.

21388 (BNWL–857) **Pacific Northwest Laboratory monthly activities report, June 1968.** Albaugh, F.W. Pacific Northwest Lab., Richland, WA (United States). Jul 1968. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012532. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document reports on direct AEC sponsored programs (Columbia River studies); assistance to Douglas United Nuclear (N-Reactor); assistance to Atlantic Richfield Hanford Company (Purex Process, B-Plant, Z-Plant); and technical assistance to the Hanford Plant (environment, dosimetry).

21389 (BNWL–925) **Pacific Northwest Laboratory monthly activities report, October 1968.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. Nov 1968. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012533. Source: OSTI; NTIS; GPO Dep.

Declassified.

Spot-radiographs, per Combustion Engineering instructions, on the head-to-shell weld, No. 160-4, on steam generator No. 4B have been completed. No weld discontinuities in excess of specification limitations were detected. Radiography on the 10-foot diameter head-to-shell weld, No. 160-4, on steam generator No. 4B, cell 4, 109-N Building, 100-N Area has been completed after stress relief. The weld complied with the requirements of the ASME Boiler and Pressure Vessel Code, Section III (Nuclear Vessels), 1968 Edition. Whole-body counts were obtained on 506 children of the Fruitland School in Kennewick. These measurements will be related to foods the students ate as indicated by diet records. It now appears that the relative merits of monitoring river temperatures at 100-F vs. Richland in relation to State standards will be more dependent upon the extent to which power levels may have to be reduced than upon the number of days out of the year when such reductions are necessary.

21390 (BNWL-CC–437) **Feasibility study for perimeter inspection of shutdown production reactors.** Fullmer, G.C.; Green, D.R.; Granquist, D.P. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. Feb 1966. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013510. Source: OSTI; NTIS; GPO Dep.

In fulfillment of a request by the Atomic Energy Commission, an inspection system was developed by the Hanford Atomic Products Operation of General Electric Company during 1964 for periodic monitoring of production reactors should they be shut down under international agreement. Ground rules included access to the reactor building and to the reactor core itself for installation, checking, and removal of equipment for determining whether or not the

reactor had been operated between periodic inspection visits. Subsequent correspondence from the Atomic Energy Commission indicated that the in-core system proposed was satisfactory for the ground rules under which it was developed, but that the Arms Control and Disarmament Agency wished also to know whether or not a perimeter inspection system would be feasible. For purposes of this study "perimeter" access at a radius of one mile was to be assumed. Hanford was asked to investigate and report on the feasibility of such a system, the extent of work to be equivalent to a Title 1 design effort. This report describes the work carried out by Battelle-Northwest on this program.

21391 (BNWL-CC–2488-RD) **Reactor output: Production information.** Synoground, M.O. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Apr 1970. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012868. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides reactor output production information for calendar year 1969.

21392 (CONF-940482–4) **A new fuel loading design for the Advanced Neutron Source.** Gehin, J.C.; Renier, J.P.; Worley, B.A. Oak Ridge National Lab., TN (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Nuclear Society (ANS) topical meeting; Knoxville, TN (United States); 11-15 Apr 1994. Order Number DE94012323. Source: OSTI; NTIS; INIS; GPO Dep.

A new fuel loading design has been developed for the Advanced Neutron Source Reactor. In this reactor the combination of a small core volume and high power results in a very high power density. Using a direct optimization procedure the thermal-hydraulic margins for oxide temperature drop, centerline temperature and incipient boiling (and thus critical heat flux) were maximized to increase the limiting thermal power from 298 MW to 346 MW compared to the previous fuel grading, while maintaining the desired peak reflector thermal flux.

21393 (DPE–837) **Fabrication and testing history prototypes and production units.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Engineering Dept. Sep 1954. 391p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–735). Order Number DE94012625. Source: OSTI; NTIS; GPO Dep.

From April, 1951 to Aug, 1954, New York Shipbuilding Corp. carried out a subcontract with E.I. du Pont de Nemours & Company that was without parallel in the shipyard's history. The work, designated the NYX Project for reasons of security, was vital to the operations of the Savannah River Plant, Aiken, S.C., which was then being designed and constructed by du Pont for the Atomic Energy Commission. It consisted of three broad parts: developmental and experimental work; fabrication and testing of a prototype unit; fabrication of production units. Five production units were ultimately built, one of them converted from the prototype. All were fabricated from stainless steel, and involved welding techniques, control of thermal distortion and tolerances never previously attempted on assemblies of comparable size. Du Pont's technical experience and the background of New York Ship in heavy construction, particularly in the fabrication of naval gun turrets, were combined from the outset to resolve the difficult fabrication problems that occurred almost daily. Representatives of both companies worked together as a team in the shops and at supervisory levels to an unprecedented extent. The report is intended primarily to summarize New York Ship's part in the project, but also includes some of du Pont's activities since the work of the two organizations was so interrelated. Because of the scope of the program, it will not always be possible to provide detailed information, but rather to record what happened in general terms. Where the reader desires more specific data, he should refer to original plans and records, including various reports compiled during the course of the project.

21394 (DPE–973-Del.Ver.) **Savannah River Plant engineering and design history: Volume 4: 300/700 Areas & general services and facilities.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Engineering Dept. Jan 1957. 460p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–736). Order Number DE94013516. Source: OSTI; NTIS; GPO Dep.

The primary function of the 300 Area is the production and preparation of the fuel and target elements required for the 100 Area production reactors. Uranium slugs and lithium-aluminium alloy control and blanket rods are prepared in separate structures. Other facilities include a test pile, a physics assembly laboratory, an office and change house, an electrical substation, and various service facilities such as rail lines, roads, sewers, steam and water distribution lines, etc. The 700 Area contains housing and facilities for plant management, general plant services, and certain technical activities. The technical buildings include the Main Technical Laboratory, the Waste Concentration Building, the Health Physics Headquarters, and the Health Physics Calibration building. Sections of this report describe the following: development of the 300-M Area; selection and description of process; design of main facilities of the 300 Area; development of the 700-A Area; design of the main facilities of the 700 Area; and general services and facilities, including transportation, plant protection, waste disposal and drainage, site work, pilot plants, storage, and furniture and fixtures.

21395 (DPW–55-141) **Enriched uranium requirements for development.** Fisher, R.E. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Feb 1955. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–711). Order Number DE94010314. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum request allocation for three tons of enriched uranium for fabrication of ingots into plates.

21396 (DPW–55-169) **U^{235} -Al slug production report carbide and carbon chemicals company, Y-12 Plant.** Worth, W.L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 1 Mar 1955. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–713). Order Number DE94010316. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides detailed process and chemical data for several batches of U^{235} Al (LMF) slugs representing both experimental and production programs. This data was provided by carbide and carbon chemicals company, Y-12 Plant.

21397 (DPW–55-189) **Extension of Battelle work for AED, du Pont.** Woodhouse, J.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 Mar 1955. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–714). Order Number DE94010317. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses the advisability of extrusion-cladding of flat plates with the objective of translating the results of this effort to the cladding of tubes.

21398 (DPW–55-193) **Forecast of uranium metal requirements for development for April, May, and June 1955.** Fisher, R.E. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 23 Mar 1955. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–715). Order Number DE94010318. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum details the quantities of uranium which are forecasted requirements for technical development for the second and third quarters of fiscal 1955. A monthly breakdown of requirements is given for the second quarter of 1955. The best current estimate is given for the third quarter. The quantities are given in short tons as ingots and dingots.

21399 (DPW–55-224) **AEC research programs in support of Savannah River.** Worthington, H. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 21 Apr 1955. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–717). Order Number DE94010578. Source: OSTI; NTIS (US Sales Only); GPO Dep.

We are transmitting information pertaining to the programs of AEC National Laboratories and other AEC contractors in direct support of the Savannah River project during Fiscal Years 1956

and 1957. Except for the continuation of the program at Horizons Incorporated to bring their work to an orderly conclusion, the major part of the support work we are recommending is associated with the development and the experimental production of extended surface fuel elements. The total cost of the support work covered in this letter is higher than that covered in our letters of past years. Several factors are responsible for this: First we are including work that was previously in progress but that was recently taken over by the SROO for funding, for example, the work at Horizons. Second, we are including the amount of support that will be required at locations that have worked for us in the past but for which we have not previously supplied forecasts, for example, at the Superior Steel Corporation. Third we are including items of work that probably will be required but for a location which can not be specified.

21400 (DPW–55-225) **Moczik Tool and Die Company, April 19, 1955.** Herries, R.R. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 21 Apr 1955. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–718). Order Number DE94010579. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. URANIUM/extrusion; PRODUCTION REACTORS/fuel elements; URANIUM; EXTRUSION; CLADDING; FUEL CANS; ALUMINIUM

21401 (DPW–55-232) **NFE program: Disassembly and shipment minutes of meeting of April 21, 1955.** Langhaar, J.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 28 Apr 1955. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–719). Order Number DE94010580. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The meeting was confined to the question of shipping whole long elements to the 200 Area versus size reduction before chipping, and had the following objectives: To acquaint the various plant groups with details of the schemes being evaluated; to review the ground rules and assumptions; to discuss the operating features of the different schemes and to determine necessary modifications.

21402 (DPW–55-312) **Savannah River fuel and target element development status.** Woodhouse, J.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 11 Jul 1955. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–730). Order Number DE94012126. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The current fuel and target element shapes of natural uranium and uranium-aluminium alloy fuel with thorium targets is presented. Extended surface elements for uranium plates and tubes are discussed. Also, enriched elements (uranium-aluminium fuel tubes – thorium target elements) fabrication is presented.

21403 (HW–7-493) **Rough notes, coefficient tests, original data.** Menegus, R.L. Hanford Works, Richland, WA (United States). 11 Jan 1945. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010876. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides the original data in the form of rough notes for production reactor coefficient tests.

21404 (HW–7-4077) **100 Areas: (For Technical Progress Letter No. 97), May 7–13.** Jordan, W.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 May 1946. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012966. Source: OSTI; NTIS; GPO Dep.

Declassified.

Physics information for the D and F piles is presented. Thermal conductivity, reactivity, and irradiation levels are included. Concerning the cooling systems: process water control, pressure drip studies, purging studies, corrosion, and gun barrel clearance of expanded graphite are discussed. (GHH)

21405 (HW–7-4266) **100 Areas: (For Technical Progress Letter No. 102), June 11–June 17.** Jordan, W.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jun 1946. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012970. Source: OSTI; NTIS; GPO Dep.

Declassified.

Operation of the D and F Piles is reported. Other items reported are: general; water, corrosion and engineering (graphite expansion).

21406 (HW–7-5169) **100 Areas technical activities report - physics, September 1946.** Montgomery, E.B. Pacific Northwest Lab., Richland, WA (United States). 9 Oct 1946. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013683. Source: OSTI; NTIS; GPO Dep.

The Pine unit was down four times during the month. These were all regularly scheduled shutdowns. Times down vary from 16.9 hours to 19.2 hours. A total of 33.4 tons of metal was discharged. The galvano-meter chamber in experimental hole "A" was replaced. One Special Request was discharged and three tubes have been loaded with Special Request samples. A new bismuth column has been established. Some difficulty has been experienced with high temperatures of both tube exit water and graphite following startup. On one occasion the normal operating level was exceeded for a short period of time.

21407 (HW–7-5172) **Graphite expansion committee meeting of October 4, 1946.** Woods, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Oct 1946. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012961. Source: OSTI; NTIS; GPO Dep.

Declassified.

Recent data show that test hole samples out from the center of a bar show greater expansion rates than do samples out from the edge of a bar. The previously noticed irregularities in expansion of test hole samples are attributed to this phenomenon. For unexplained reasons, the expansion of the graphite piles is in close agreement with the smaller expansion rates shown by test hole samples rather than with the larger rates. It is recommended that the neoprene coal on the far side of the F pile be placed before the end of the year. It is recommended that the neoprene seal on the near side of the D Pile be replaced after replacement neoprene is on hand. It is recommended that the compressed cork and about 4 inches of the cement block was in back of the Third Safety Tanks at the D Pile be removed at the time of replacement of the neoprene seal, and that the resulting gap be covered with a flexible air-impermeable membrane such as rubberized canvas. Actual measurement of the length of graphite between the gun barrels of Tube 3671-B confirms the predicted end-wise expansion of the graphite as deduced from jacking tests on this tube assembly. This technique, which involves tube removal, is viewed with favor as a superior way to determine end-wise expansion in cases where the jacking tests indicate anomalous expansion. Initial tests on the plug device used for monitoring Van Stone flanges have demonstrated that the equipment has satisfactory speed and precision. Lock-up studies on a few Van Stone flanges indicate that a flange can be stretched as much as 0.05 inches before rupture occurs. Further tests are in progress.

21408 (HW–7-5324) **100 Areas technical activities report – Physics, October 1946.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Nov 1946. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013502. Source: OSTI; NTIS; GPO Dep.

The D Pile was down five times for scheduled shutdowns. The fifth shutdown was of short duration for the purpose of discharging temporary "P" columns. Details of the shutdowns are given. Three new bismuth columns were established, Special Requests were charged into seven tubes and three Special Requests were discharged. Three tubes were charged with four-inch slugs. The power level of the F Pile has been corrected for the discrepancy noted last month. Material for irradiation under the Special Request program was charged into six tubes and the B experimental hole during the month. The effect of poison columns and rods on the temperature distribution of the pile was checked for the overall content of the pile. The F Pile gained two in hours in cold, clean

reactivity during the month if allowance is made for xenon poison values corresponding to 190 MW for the beginning of the month and 200 MW at the end of the month. The graphite stringer removed from the "D" test hole of the D Pile on 3-12-46 was studied physical radiation effects.

21409 (HW–7-5602) **100 Areas technical activities report - physics, December 1946.** Montgomery, E.B. Pacific Northwest Lab., Richland, WA (United States). 7 Jan 1947. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013684. Source: OSTI; NTIS; GPO Dep.

This report summarizes physics experiments carried out in different parts of the 100 area at Hanford during December, 1946. This included work on the D pile, F pile, and experiments aimed at studying the irradiation properties of graphite and metal samples exposed to different radiation environments. Pile tests included reactivity tests, calibrations of control rods, and power coefficient tests.

21410 (HW–7-5940) **100 Areas technical activities report: Physics, February 1947.** Gast, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Mar 1947. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013499. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document details 100 Areas technical activities in reactor physics research and operation for the month of February 1947.

21411 (HW–7-5987) **Hanford Engineer Works Technical Progress Letter No. 142, March 16 through March 22.** Wende, C.W.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Mar 1947. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013500. Source: OSTI; NTIS; GPO Dep.

This weekly report briefly describes the status of projects in three main divisions: (1) Pile technology: physics and engineering; (2) Separations: 200 area plant assistance (canyon buildings, concentration buildings, and isolation building); redox development; and stack gas disposal; and (3) Metallurgy and control: laboratories; nitric acid; 300 area plant assistance; metallurgy laboratory; and statistics.

21412 (HW–7-6254) **100 Areas technical activities report - engineering, April 1947.** Woods, W.K. Pacific Northwest Lab., Richland, WA (United States). 21 May 1947. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013685. Source: OSTI; NTIS; GPO Dep.

This is the first of a series of monthly reports covering details of the work of the Engineering Group of the Pile Technology Section of the Technical Department. The monthly Slug Inspection Report is being discontinued as a separate document and is being incorporated in this group report. Included is work on corrosion and blistering; graphite expansion; and irradiation studies.

21413 (HW–15427) **100 Areas technical activities report: Physics, November 1949.** Carson, A.B. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Nov 1949. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012040. Source: OSTI; NTIS; GPO Dep.

Declassified.

Work of the pile physics and experimental physics groups is reported. Theoretical work is also reported.

21414 (HW–22082) **Induced activities in a recycling control solution.** Drummond, W.E. Hanford Works, Richland, WA (United States). 5 Sep 1951. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006078. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document addresses questions concerning radioactive build-up in a liquid control solution recycling through the pile at the Hanford Works plant. The solution composition and method used to obtain dose rates are included.

21415 (HW–49673-RD) **Hot semiworks summary: Run PX-18.** Murray, J.L.; Sloat, R.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Mar 1957. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012815. Source: OSTI; NTIS; GPO Dep.

Declassified.

Hot Semiworks Run PX-18 was made to compare HA Column decontamination using HAF prepared by either updraft, or downdraft dissolving. Also determined were the effects on IA Column performance of (1) using Versene washed solvent, and (2) of addition Versene to the IAF and IAS. The Purex plant low-acid flowsheet was used during PX-18. No change in HA Column decontamination was noted which could be directly attributed to the change from updraft to downdraft dissolved feed. However, HA Column decontamination factors were increased by a large factor using either types of feed when the scrub section was operated "loaded." For the most part the periods of "loaded" scrub section and high decontamination factors were accompanied by unstable operation and excessive waste losses. The use of Versene as an additive to the IAF, (0.0013 M) and IOS (0.001 M) produced an increase in IA Column decontamination. The IAF to IAP decontamination factor increased 60 to 70% to 350 as indicated by the in-line analyses, while a single lab analysis indicated a factor of five improvement. It was not possible to determine whether the increased decontamination resulted from the use of Versene in the organic wash solution or from its introduction in the IAF and IAS streams.

21416 (HW–56351-RD) **Secondary corrosion barriers: Application.** Evans, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Jul 1955. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010596. Source: OSTI; NTIS; GPO Dep.

Declassified.

A program to develop a new fuel element was initiated at Hanford in 1951. A survey of the possible methods of making such a fuel element was completed and a document listing all possible lines of research was written. The problem was outlined as it appeared at that time; various developments which have occurred subsequently have changed this problem to a greater or lesser extent. Essentially the problem concerned the development of a fuel element which would not fail or would fail in a slow and predictable manner and would not cause damage to the pile. A largenportion of the research and development was concerned with the application of these layers. This paper will review the research that was done on the development of these corrosion-resistant layers and will evaluate the problem as it appears now after approximately four years have elapsed.

21417 (HW–57005) **Report of meeting on the AlSi bonding layer.** Todd, R.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Aug 1958. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010605. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details a meeting held for the purpose of acquainting all interested parties with the present problems being encountered in the canning process. A short discussion of previous canning methods and their problems was presented as background information. The search for a bonding agent to bond the aluminum can to the uranium core covered such materials as AlSi, lead, tin, aluminum, and copper. Mach of this early work was guided by the University of Chicago. The Grasselli (du Pont) Laboratory developed the triple-dip process where the uranium was first heated in a copper-tin bath, rinsed in a tin bath, then canned in an AlSi bath with AlSi as the bonding agent. It appeared at this time that the best AlSi composition to use was a little toward the aluminum side of the eutectic composition of 12.5 percent silicon. A current problem and the one with which this meeting was primarily concerned is that of bond failure where the bond between the can and core is broken. Variables found in this most recent study to have an effect on the strength or quality of the bonding layer are discussed.

21418 (HW–57166) **Reactor statistics, April, 1961–April 1962.** Burke, R.C. (General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation). General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation; Pacific Northwest Lab., Richland, WA (United States). 11 May 1962. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010563. Source: OSTI; NTIS; GPO Dep.

Declassified.

The primary effort to date in connection with this study has been directed toward obtaining source data which indicates (1) the functions performed during reactor outages and the distribution of time required to accomplish these corrective functions, (2) the groups of crafts associated with each of the recovery functions performed, and (3) the radiation exposures experienced during these activities. The first phase of preliminary analysis has been based on the "time accountability" report data originated by the various reactor analysts. The attached computer tabulation is one of the analyses performed considering the time and date a reactor was shut down, the "cause" for which it went down and the time and date the reactor was considered back on-line. The report summarizes these accountability data into the following summaries in the order presented below: (1) Total hours down per reactor per cause. (April, 1961 to April, 1962) (2) Number of records indicating experience of outages per reactor per cause. (3) The average and standard deviation; same relationship. (4) Outage summary; total hours down, percentage contribution to the department total outage, and time operating efficiency. (5) Department summary (self explanatory). (6) through (21). Interval between like outages by cause. These reports illustrate which reactor was hit by the various problems during the year, how many times it was involved, and the number of hours lapsed between each like shutdown cause. Department summary of outage interval report; (This again is a preliminary analysis to determine whether there is sufficient data to make sound statistical conclusions regarding outage time-cause relationships).

21419 (HW–57188) **Effects of preheat time in compound layer formation.** Strand, C.A.; Padgett, E.V. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Aug 1958. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010627. Source: OSTI; NTIS; GPO Dep.

Declassified.

Hanford fuel elements are made by brazing uranium cores in aluminum cans. The interface, or junction, between the AlSi braze and uranium core known as the compound layer, is composed of an intermetallic complex. The properties of this compound layer, brittleness, ductility, toughness, are considered to have a pronounced influence on the performance of fuel elements in the reactors. This report presents the results of initial efforts to identify the compound layers and establish some of the process conditions and variables which influence the properties of the compound layer, in particular, the lead preheat time.

21420 (HW–57394) **Nuclear physics research operation: Monthly report, August 1958.** Faulkner, J.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Sep 1958. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010902. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details activities of the Nuclear Physics Research Operation for the month of August 1958.

21421 (HW–57735) **Revision to technical criteria and bases pressurized, water cooled, graphite moderated production reactor.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Oct 1958. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012023. Source: OSTI; NTIS; GPO Dep.

Declassified.

Attached is a draft of revisions being made to subject document, HW-53612. These revisions pertain to the moderators only, and will be incorporated in an overall revision of the technical criteria, which will be issued soon. Requirements, criterion, and data are included.

21422 (HW–57812) **Recommendation for fuel element change: C Reactor.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Oct 1958. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012703. Source: OSTI; NTIS; GPO Dep.

Declassified.

It is recommended that the following described I & E fuel element pair be evaluated for rupture rate improvement, and if significantly improved, recommended for C Reactor usage. Operating conditions are estimated.

21423 (HW–58205) **Fuels Development Operation quarterly progress report, July– September 1958.** Cadwell, J.J.; Tobin, J.C.; Minor, J.E.; Evans, E.A.; Bush, S.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1958. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013506. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details activities of the Fuels Development Operation for the months of July, August, and September 1958.

21424 (HW–58253) **Production test IP-214-A, irradiation of enriched Zircaloy-2 jacketed seven-rod cluster elements.** Kratzer, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Nov 1958. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012699. Source: OSTI; NTIS; GPO Dep.

Declassified.

Four Zircaloy-2 jacketed enriched seven-rod cluster elements, one three-foot three-rod Zircaloy-2 jacketed enriched cluster element with integral end closures, and two eighteen-inch Zircaloy-2 jacketed wire wrapped cluster elements containing UO_2 will be irradiated at jacket surface temperatures up to 270 C in the KER loops to an exposure of 3500 MWD/T on the enriched seven-rod cluster elements.

21425 (HW–58266-RD) **Results of heat decay test.** Hall, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Nov 1957. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012809. Source: OSTI; NTIS; GPO Dep.

Declassified.

During the outages of 9-28-57 and 10-14-57 a test was performed at KW-Reactor to evaluate conditions present during front nozzle replacement programs. The intent of the test was to prove that backflow from the rear crossheader would provide sufficient cooling to prevent slug damage under the following conditions: 1. The reactor has been shut-down at least eight hours. 2. The headers which supply rows of nozzles to be replaced are valved to the relief riser on the rear, and throttled to a header pressure of 26in. on the front. 3. No tubes may be open on the rear. 4. NO tubes closer than five lattice units on the front may be opened at the same time. 5. A maximum of five tubes per header may be open at one time. The test procedure used was to pick a high factor tube at goal exposure, obtain the above conditions, disconnect the front pigtail and remove the nozzle cap. The temperature of the backflow water was used with a previously calibrated thermometer, and the flow was measured with a calibrated bucket. One minute readings of temperature were obtained until the system attained equilibrium after which final conditions were obtained for rear inlet water temperature, front outlet water temperature, and flow rate-tube 3077-KW during the outage of 9-28-57, and six times with tube 1972-KW during the outage of 10-14-57. A summary of data are included in the appendix as well as a copy of the resultant procedure.

21426 (HW–58281) **I&E depleted uranium fuel element ruptures experienced under PT-IP-132-AC.** Blanton, W.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Dec 1958. 13p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013498. Source: OSTI; NTIS; GPO Dep.

Beginning in February, 1958, a sufficient quantity of seven-inch dip canned I & E depleted uranium fuel elements was prepared for irradiation to produce eleven kilograms of plutonium, containing at least twenty per cent of the Pu-240 isotope, as authorized by the Atomic Energy Commission. Subsequently, eighty-four columns in C reactor were partially charged with the finished depleted fuel under PT-IP-132-AC. To date, ten depleted ruptures have been sustained, after being irradiated six to eight months toward a planned accoumulated goal exposure of 210 MWD per column or a total irradiation time approximating 12–14 months. The mechanism and cause of these failures is being thoroughly investigated. This document summarizes the fabrication history, irradiation experience to date, rupture examinations, and an investigation of process conditions which may have contributed to the high incidence of ruptures.

21427 (HW–58282) **K Reactor natural I&E goal exposure.** Music, J.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Nov 1958. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012810. Source: OSTI; NTIS; GPO Dep.

Declassified.

Return can be increased on the order of $1000 to $2000 per calendar day at each K Reactor if the goal exposure for natural I & E slugs is reduced from 800 to 700 MWD/T. This gain is predicated on primarily a decrease in rupture losses. The recommended goal is a straight line on a linear graph of exposure in MWD/T versus maximum tube power in kw per tube, passing through the following two points: (850 kw/tube, 900 MWD/T); (1400 kw/tube; 490 MWD/T). In addition, I & E natural uranium charges running below 850 kw, if any, should be discharged not higher than 900 MWD/T. At a maximum tube power of 1300 kw, the recommended goal will give a weighted average exposure of about 700 MWD/T. Power at which a tube operates should be determined as recommended in HW-57937, "Goal Exposure for Enriched I & E Material at the C and K Reactors." These are interim recommendations. We expect to recommend some changes in the goal, for reasons explained below. The recommended goal was calculated on the IBM-650, using an equation for return. The equation included, we believe, proper allowance for all but two factors. Principle affecting factors were included.

21428 (HW–58481) **Interim report, Operational physics aspects of supplement A: Production test IP-14-AC, Use of E metal in shield protection.** Bunch, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Dec 1958. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011070. Source: OSTI; NTIS; GPO Dep.

Declassified.

The masonite in the old pile shields is deteriorating because of the temperature conditions to which it is subjected. One method of mitigating this deterioration is to reduce neutron leakage to the shields by utilizing the fringe tubes for target material. One possible target material is depleted uranium, i.e., uranium from which the bulk of the isotope 235 has been removed. The purpose of this test supplement has been to irradiate a fringe depleted pattern to establish the enrichment loading of E metal necessary to maintain reactor production, to determine the depression in shield temperature which could be obtained by such a loading, and to establish the operational economics of this method of production. The latter of these goals is to be the subject of a later report. With full length depleted uranium charges in the outermost fringe process tubes the heat generation rate in the adjacent shields is reduced to approximately 75 per cent of the value for a natural uranium loading under comparable reactor conditions. The reactivity compensation can be achieved by the use of one and one-half full length E columns for each depleted column where the E charges are placed in the second an third tube rows from the reflector. These results substantiate calculational techniques developed earlier.

21429 (HW–58511) **Production test IP-165-C continuous monitoring of front-to-rear flux balance, Final report.** Bunch, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Dec 1958. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012022. Source: OSTI; NTIS; GPO Dep.

Declassified.

Nuclear reactors which contain a significantly large volume operating at or near the same flux level are subject to oscillations of the maximum flux from one region of the reactor to another. To control these flux movements it is necessary to know the location of the flux "peaks" and "valleys" and the rate of change of the flux at these points. Existing monitoring instruments readily present only a two-dimensional picture of the flux distribution within the reactor; the front-to-rear distribution must be inferred from graphite temperatures or octant monitoring chambers which are not ideally suited for the job. The objective of this test vas to evaluate a paired-column arrangement for continuously monitoring the front-to-rear flux balance in one region of the reactor and to control any significant unbalance with the prototypic slug column displacement equipment.

21430 (HW–58648) **100-N temporary construction line considerations.** Mollerus, F.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Dec 1958. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012698. Source: OSTI; NTIS; GPO Dep.

Declassified.

Present thinking and planning appears to be developing from the following factors as concern the 13.8 KV temporary construction power limit. 1. It is understood that the present intent is to supply 100-N operating requirements from a single stub source in the 230 KV loop. 2. The original thoughts were to obtain construction power over a 13.8 KV line from 151-D substation. 3. Construction load requirements are now less than originally planned since steam has been substituted for electrical drive of primary loop pumps and 5500 hp motor tests are no longer necessary. 4. An extreme emergency backup source for the K plants has always been of concern, although minimized in recent planning. It is desirable to review the temporary construction line requirements from a future operating viewpoint to determine if the line could be useful to the operating plants after completion of construction. It is highly desirable to provide T.C. power source from K plants rather than 151-D and then leave the line and breakers in place for future maintenance assistance and as extreme emergency backup to K plants.

21431 (HW–58784) **Calculations of buildup of plutonium isotope and burnout of U^{235} in 1.44% U^{235} enriched uranium.** Niemuth, W.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Dec 1958. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013497. Source: OSTI; NTIS; GPO Dep.

In order to investigate the rupture stability of uranium elements irradiated at power generations per unit length larger than those encountered in natural uranium fuel elements, three partial columns of 1.44% U^{235} enriched, internally-externally cooled, uranium elements were irradiated in PT-IP-1-A. After discharge and examination of the fuel elements 25 pieces (182.5 pounds) of this metal were available for special analysis of U^{235} burnout and plutonium content. The average exposure of these pieces was 2,187 ± 6% MWD/Ton. The purpose of this document is to summarize some calculations of buildup of plutonium isotopes and burnout of U^{235} in an attempt to correlate calculations with the results from experimental analysis.

21432 (HW–59007) **Final report on PT-105-630-A: Pile power distribution control at the K piles.** Brugge, R.O. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Feb 1959. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012030. Source: OSTI; NTIS; GPO Dep.

Declassified.

Following-the K-pile start-ups in early 1955, a program of planned power raises was begun. The operating level had reached 1700–2000 MW by late 1955, and a severe operational control

problem became apparent; the power distribution in the reactor was difficult to control and appeared inherently unstable. A study of available data led to the initiation of a production test so that a more detailed study of the phenomena could be made. This report describes the measures taken which led to an improvement in the operating characteristics of the K-piles; the current status and future outlook are also discussed in a general way.

21433 (HW–59943-RD) **Exposure, power, and temperature effects on rupture rates of solid fuel elements.** Jaech, J.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Apr 1959. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012818. Source: OSTI; NTIS; GPO Dep.

Declassified.

In this report, the equation (HW-55219-RD) expressing tube-wise rupture rate as a function of exposure, power, and temperature has been adjusted to include 1958 data.

21434 (HW–59944-RD) **Analysis of data from IP-56-A-86MT: Evaluation of dimensional stability characteristics of low hydrogen uranium I and E fuel elements.** Stewart, K.B. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Apr 1959. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012690. Source: OSTI; NTIS; GPO Dep.

Declassified.

This production test was designed to evaluate the suitability of low hydrogen dingot uranium as routine process material. Nine tubes of I and E fuel elements (6 dingot, 3 ingot) with 32 fuel elements in each tube, have recently been discharged at the C Reactor and this document contains the results of analyses made on the dimensional stability properties of this material.

21435 (HW–59975) **Power rate meter response characteristics.** Simpson, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Apr 1959. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012814. Source: OSTI; NTIS; GPO Dep.

Declassified.

Power rate of rise measuring instrumentation is being procured for all of the Hanford piles, and a prototype installation is now in service at D reactor. This instrumentation is expected to provide valuable assistance to the pile operator during the start-up rise to operating power; in order to best utilize the instrument, procedures and limits must be determined on the basis of the relationship between the flux rate of change and the instrument response. As with any measuring instrument, there is an inherent delay in the power rate meter circuitry; in addition there are greater delays associated with the beat capacity of the metal and water and the transit time of the cooling water. Furthermore, reactivity changes from rod withdrawal and metal coefficient draping are not instantaneous, and the flux is not a simple function of the reactivity changes. Because of the time lags involved the rate meter response cannot be identical to the actual flux rate of change; however, an exact solution for this response in terms of all of the variables would be inordinately complex. The purpose of this study is to show approximately the changes in power level or rate which might occur in practice relative to the instrument indications, and to point out how the differences may be considered in setting realistic operating standards with neither undue risk nor unwarranted conservatism. This analysis is intended also to provide the technical background for a production test to check the accuracy of the approximate calculations. Together with the results of the intended test and of additional analog calculations, this report will provide the basis for Process Standards governing procedures for pile start-up using the power rate meter.

21436 (HW–60747) **Design criteria – Modification of fuel element test facilities: 1706-KER Project CGI-839.** Rudock, E.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Aug 1959. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013509. Source: OSTI; NTIS; GPO Dep.

The following criteria outlines the basis, objectives, and fundamental methods that shall govern the preparation of final design for "Project CGI-839, Modification to Fuel Element Test Facilities – 1706 KER." These modifications will provide the equipment to test NPR size fuel elements in the KER recirculating loops. The 1706-KER Recirculation Test Facility of KE Reactor is operated to obtain experimental data regarding high temperature reactor coolant technology and high temperature fuel element testing. The facility consists of four in-pile recirculating loops. These loops will permit testing of fuel elements with the existing process tubes of 2.1 inches I.D. To provide adequate in-reactor fuel element test facilities to support the development of NPR fuel, two KER loops, #3 and #4 will be converted to provide a process tube of 2.7 inches ID that will be operated at typical NPR irradiation conditions. The remaining loops No. 1 and 2, will be modified to provide additional flow and heat transfer capacity for greater flexibility in the testing of high temperature fuel elements smaller than the NPR size. New pumps, heat exchangers, and minor piping modifications will be required in all loops.

21437 (HW–60897) **Technical basis for establishing process tube pressure limits for KER loops 2 and 3 and for the NPR Prototype Facility.** Adams, O.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Jun 1959. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012705. Source: OSTI; NTIS; GPO Dep.

Declassified.

In compliance with a request from Coolant Testing Operation, the Reactor Engineering Operation has made a study to determine the maximum operating pressure limits for the pertinent Zircaloy-2 process tubes. Since these tubes shall be used for testing NPR fuel elements, it is considered desirable that KER Loops 2 and 3 permit operation at temperatures of around 300°C while the NPR prototype facility permit operation at about 316°C in a manner such that there is minimum hazard to the KE-Reactor and to personnel.

21438 (HW–60962-C-RD) **PT-IP-269-A-FP, evaluation of the stability of cores from extruded tubes.** Hall, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Nov 1959. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012804. Source: OSTI; NTIS; GPO Dep.

Declassified.

If material received under this program is deemed acceptable for reactor charging, this test will authorize irradiation of fourteen monitor columns which shall be discharged at 200, 400 and 800 MWD/T to observe the performance of this material. This test shall run concurrently with irradiation of quantities up to 60 tons/month to be authorized separately.

21439 (HW–61400-RD) **Topical material prepared for agenda: E. J. Block meeting.** Nilson, R. (ed.). General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Jun 1959. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012874. Source: OSTI; NTIS; GPO Dep.

Declassified.

The material covered are R and D, 2000 reactor and metallurgy program (production reactors, N-Reactor). Topics covered include operating schedules and production, fuel, engineering, safety, control, physics, etc.

21440 (HW–61576) **Irradiation summary – PT-IP-179-A-97-FP: Evaluation of the effect of a modified Beta-Heat treatment cycle on dimensional stability of uranium fuel elements.** Peacock, D.W.; Hall, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Aug 1959. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012707. Source: OSTI; NTIS; GPO Dep.

Declassified.

The air quench prior to water quench during core heat treatment can be used to control slug distortion. In August 1959, a production test authorized the charging of 16 tubes of 43-second air quench material alternated with standard control material in C-Reactor. The test was charged on November 24, 1958, and discharged on April

26, 1959. This report summarizes and evaluates the irradiation performance of the material.

21441 (HW–61619-D) **Daily data sheets – PT-IP-280 A: Ingot-alloyed dingot D-Reactor.** Hall, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Apr 1960. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012877. Source: OSTI; NTIS; GPO Dep.

Declassified.

The data consists of out and inlet temperatures, and panellit and header pressures, sorted according to date and tube-pile.

21442 (HW–61730) **Production test authorization IP-217-A-supplement, uranium sample irradiation (HAPO-218).** Zima, G.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 31 Aug 1959. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012880. Source: OSTI; NTIS; GPO Dep.

Declassified.

The object of this production test is to authorize the irradiation of samples of natural uranium for use in the fission product volatilization program. Any empty central zone PCCF and/or process tube at B, D, DR, or H Reactors will meet the requirements of this authorization.

21443 (HW–63009) **Examination of a severely pitted X-8001 alloy clad fuel element (RM-303).** McMahan, M.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Dec 1959. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012822. Source: OSTI; NTIS; GPO Dep.

Declassified.

An X-8001 clad, I & E natural uranium fuel element irradiated in tube 2762D to 886 MWD/T was discharged in February 1959 and sent to Radiometallurgy Laboratory for examination at the request of Irradiation Processing Department. After discharging tube 2762D which was loaded with X-8001 clad fuel elements, a fuel element (KL018D) was observed to be very badly pitted. Visual and photographic inspection revealed the pits had penetrated into the AlSi layer. The pitting appeared as the result of erosion-corrosion as there was no evidence for intergranular or transgranular corrosion and no mechanical deformation. Chemical analysis for %Ni and Fe indicated normal concentrations.

21444 (HW–63122-C) **PT-IP-297-A-FP, The effect of autoclave film damage on the incidence of groove pitting on X-8001 alloy fuel jackets.** Hall, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Apr 1960. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010956. Source: OSTI; NTIS; GPO Dep.

Declassified.

The objective of this test is to evaluate the hypothesis that autoclave film damage is a necessary condition for groove pitting of X-8001 alloy fuel cladding.

21445 (HW–63159) **Technical description of the new SS accountability program on the IBM-709.** Richey, C.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Jan 1960. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012029. Source: OSTI; NTIS; GPO Dep.

Declassified.

The SSA 100 program will compute the buildup and decay of SS materials, (gms Pu, U-235 burnout and uranium burnout) in fuel that has been irradiated in any of the Hanford reactors. The routine input data for the program are the IBM production records supplied by the Production Forecasting and Scheduling Operation. The purpose of this program is to compute and prepare an accurate accountabilty report with a minimum of manual effort. This can either be a report for fuel discharges from the reactors or a report of the entire month end reactor inventory. It is not the purpose of this report to describe in detail the data processing techniques used to provide the accountability reports, this will be left to the discretion of the SS Accountability Operation and the programer. The purpose of this report is to present (1) the technical methods that are fundamental to the program, (2) the necessary instructions that are necessary to make changes or include additional fuel data on the data tape and (3) the necessary instructions such that buildup and decay data can be obtained for fuel elements on a non-routine basis.

21446 (HW–63756-3) **Laboratory determination of normal operating flow rates with the 105-F rear face floating nozzle.** Findlay, J.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Feb 1960. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012539. Source: OSTI; NTIS; GPO Dep.

Declassified.

A new rear nozzle has been developed by Mechanical Development (A), IPD to alleviate the stuck gun barrel problem on the process tubes at F reactor. This nozzle is called the 105-F rear face floating nozzle (RFFN) and is shown in Figure 4. The purpose of this study was to determine the hydraulic operating characteristics of this nozzle and to compare these characteristics with those of the standard nozzle assemblies. This report is essentially an addendum to EW-63756 1 which presented energy loss data for various outlet fitting assemblies for possible use on the BDF type reactors The experimental data for this study were obtained with the use of the hydraulics mockup in the 189-D Thermal Hydraulics Laboratory.

21447 (HW–63904) **Energy release per fission in the Hanford reactors.** Morgan, W.C.; Bunch, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Feb 1960. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010613. Source: OSTI; NTIS; GPO Dep.

Declassified.

The average energy release per fission event in a reactor is dependent on the composition and arrangement of the lattice materials. In a study of heat generation in the NPR, Nilson developed expressions for calculating the average energy released in each material per fission event. These relationships have been used in the present calculations to obtain the energy release per fission in existing Hanford reactors.

21448 (HW–64038) **Rezoning of fringe at 105-KE Reactor.** Leitz, E.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Feb 1960. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012819. Source: OSTI; NTIS; GPO Dep.

Declassified.

A study was made to determine the optimum arrangement of the fringe flow zones at KE Reactor. Also considered, was the possibility of converting part or all of the existing fringe zone (actually three flow zones) from solid metal to I & E metal to decrease rupture potential in these low flow zones. The necessity for this study was indicated by high tube outlet temperatures in the fringe flow zones and the recent occurrence of two solid metal ruptures in process tubes located in the fringe zone of the reactor. Two additional solid ruptures occurred during the period that conversion to I & E in zone 2, as recommended below, was being completed.

21449 (HW–64404) **Scope report Safety Circuit Trip Identification System.** Deichman, J.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Mar 1960. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011267. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to establish the scope of a project to provide a system which will quickly and accurately identify the sources of all reactor scrams.

21450 (HW–64458) **Water plant modifications for increased production at B, C, D, DR, F, and H Reactors.** Brinkman, L.B.; Corley, J.P. General Electric Co., Richland, WA (United States).

Hanford Atomic Products Operation. 15 Apr 1960. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012956. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to define the extent of modifications necessary to increase capacities of the 100-B, C, D, DR, F, and H water plants for reactor flows of 90,000 95,000 105,000 and 115,000 GPM, and to provide supporting data for budget studies for increased production.

21451 (HW–64560) **Hydraulic demand curves for standard BDF geometry at low tube powers.** Waters, E.D.; Fitzsimmons, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Mar 1960. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010991. Source: OSTI; NTIS; GPO Dep.

Declassified.

Information concerning the pressure-flow relations in reactor process tubes at very low heat generation rates is of value for determining flow requirements during shutdown conditions. Since such information is quite difficult to calculate when boiling occurs, a brief laboratory investigation was conducted to obtain experimental data. The data obtained for BDF geometry are recorded in this report for distribution to those persons having an interest in the application of the results to reactor operation.

21452 (HW–64618) **Finished fuel and target dimensions.** Hagie, L.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Apr 1960. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010990. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/fuel elements; HANFORD PRODUCTION REACTORS/targets; FUEL ELEMENTS/dimensions; TARGETS/dimensions; HAPO; TARGETS; DIMENSIONS; IRRADIATION; RADIATION EFFECTS

21453 (HW–64703) **Irradiation effects on Zircaloy-2-uranium bonds.** Goffard, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Apr 1960. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011994. Source: OSTI; NTIS; GPO Dep.

Declassified.

The failure mechanics of high exposure, in-reactor coextruded fuel rods are quite different from those of defected unirradiated rods. The appearance and corrosion behavior of the high-exposure in-reactor failures suggests that the strength of the coextruded Zircaloy-2 to uranium bond has deteriorated. Notch-fracture tests, in which the strength of the Zircaloy-2 clad to uranium bond is evaluated in a qualitative manner, suggests that the bond strength has not deteriorated to the degree indicated by the failure behavior. It is believed that the irradiation induced property changes of the uranium fuel and not a deterioration of the character of the bond are responsible for the difference in irradiated and unirradiated failure behavior.

21454 (HW–64802) **In-reactor rupture testing of Zircaloy-2 clad seven-rod cluster fuel elements.** Call, R.L.; Kaulitz, D.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1960. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012017. Source: OSTI; NTIS; GPO Dep.

Declassified.

Three tests have been run in the ETR in high temperature, high pressure, recirculating water. In one test, previously unirradiated fuel elements were used and in the other two the fuel was irradiated to 2400 MWD/T at HAPO prior to insertion in the ETR. Failure was initiated by shearing off a projection on the surface of one rod of a fuel element, thus opening a 25-mil hole through the cladding. The projection was sheared off by a hydraulically operated chisel controlled from outside the reactor. The first test was operated seven hours after the defect was opened with no failure. Failure is defined as having occurred when sufficient uranium oxide has formed to split open the cladding and release large amounts of fission products into the loop water. The second test was operated for fourteen hours after the defect was opened with again no failure. The third test was operated for only 33 minutes after the defect cap was sheared off before fission product activity in the loop water caused the test to be terminated.

21455 (HW–64819) **Hydraulic studies to aid in design of bumper fuel elements for O reactors.** Waters, E.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Apr 1960. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012709. Source: OSTI; NTIS; GPO Dep.

Declassified.

In-reactor tests of self supported fuel elements is ribless process tubes have shown a significant reduction in hot spot failure incidents. It is believed that the support rails prevent gross fuel element cocking or misalignment which would allow inadequate cooling of a portion of the fuel element. It is reasoned that if similar spacing devices were attached to fuel elements for use in present ribbed tubes an appreciable reduction in hot spot failures would result. The problem then remains to select suitable spacing devices hereafter called called "bumpers" and to assess the increased energy losses associated with their use. Efforts to predict the energy losses which may be caused by fuel element support rails on bumpers have been somewhat discouraging. The odd shape of the support rails which appear something like a close-coupled suitcase handle preclude the rigorous use of available drag coefficients or contraction expansion coefficients. Hence it is necessary to make pressure drop measurements with a fuel elements design (size) which is considered to be quite close to meeting the actual pressure flow requirements. Then the final design is determined in view of these data. The data of this report were obtained in the 189-D Hydraulics Laboratory to study the hydraulic characteristics of a specific fuel element size in a standard BDF ribbed process tube. The data allow determination of the effect of attaching "bumpers" to this size of fuel element. Although the bumper fuel elements for actual reactor usage will probably be of the I&E type, the elements used in these tests were of solid type in order to eliminate the parameter of hole channel flow which lends itself quite well to analytical correlation. The data will aid in selecting the final fuel element design (size) and should not be interpreted as representing pressure drop or flow rate changes which may result from reactor usage of bumper fuel elements of an ultimate design.

21456 (HW–64936) **In-reactor corrosion: A paper presented at the 9th annual AEC Corrosion Symposium, Boston, Massachusetts, May 10–12, 1960.** Larrick, A.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 May 1960. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-600505–1: 9. annual Atomic Energy Commission corrosion symposium, Boston, MA (United States), 10-12 May 1960). Order Number DE94012036. Source: OSTI; NTIS; GPO Dep.

Declassified.

Object of this paper is to present preliminary results of experiments in Hanford in-reactor loops to determine if exposure to neutrons will increase corrosion rates of Al alloys, Zy-2, and 304 stainless steel. Results were negligible or no corrosion.

21457 (HW–65009) **In-reactor rupture testing of Zircaloy-2 clad seven-rod cluster fuel elements: Interim report.** Call, R.L.; Green, J.W.; Kaulitz, D.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 May 1960. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012021. Source: OSTI; NTIS; GPO Dep.

Declassified.

The high pressure loop installed in the 3X3 reflector position of the ETR and the associated instrumentation to detect and study failure mechanisms handled the rupture tests without difficulty. Failure of the elements was initiated by shearing off a projection on the fuel elements. The first test of the series used previously unirradiated seven-rod clusters. After the projection was sheared off the fuel elements were operated for seven hours with no failure.

Failure is defined as having occurred when sufficient uranium oxide has formed to split open the cladding and release large amounts of fission products into the loop water. The second and third tests used fuel which had been irradiated to 2400 MWD/T at Hanford prior to insertion into the ETR. The second test was operated for 14 hours after the projection was sheared off–again with no failure. The third test was operated for only 33 minutes after the projection was sheared off before fission product activity in the loop water caused the test to be terminated.

21458 (HW–65330) **An evaluation of the reactor neutron spectrum.** Bunch, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 25 May 1960. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012033. Source: OSTI; NTIS; GPO Dep.

Declassified.

The neutrons in an operating nuclear reactor are generated primarily by the fission events which are taking place. The great bulk of these relatively high energy or fast neutrons are slowed down or thermalized by a series of elastic collisions with the moderator nuclei which comprise the bulk of the volume of the reactor core. Once slowed down, the neutrons diffuse through the reactor core until they are absorbed or eliminated by some other process. Each of these three groups of neutrons, i.e., the fast or source neutrons, the intermediate or slowing down neutrons, and the slow or thermal neutrons, has a characteristic energy distribution. At a constant power level or rate of fissioning, an equilibrium is soon established among the groups at any point in the reactor. If it is assumed that a smooth transition exists between the different energy groups, it is possible to evaluate the entire neutron spectrum at a point in the reactor by determining the parameters which characterize each of the three groups. This has been done in the F Reactor Quickie Facility using radioactivants.

21459 (HW–65482) **Anticipated heat generation rate of MGCR-III fuel element as a function of enrichment.** Bunch, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Jun 1960. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011302. Source: OSTI; NTIS; GPO Dep.

Declassified.

The DR-1 Loop, located in the C test hole of the DR Reactor, provides a high temperature, recirculating gas-cooled facility for the irradiation of experimental fuel elements. The loop is being utilized currently by General Atomic, a Division of General Dynamics, to evaluate fuel elements in support of their work on the Maritime Gas-Cooled Reactor Program, a program which is directed at the development of a ship propulsion unit consisting of a gas-cooled reactor driving a closed cycle gas turbine. The loop irradiations for this program require that the experimental fuel elements be maintained at specific test conditions. It is also necessary that all of the loop components be kept within certain operating limits. Therefore, the power generation rate of each experimental fuel element must be evaluated and established as accurately as possible prior to insertion in the loop. One method of establishing the enrichment required to obtain a required heat generation rate in an experimental element is to irradiate a nuclear mock-up of the assembly in the Hanford Test Reactor to determine the relative neutron density within the assembly and the reactor. This report presents the results of such irradiations using the MGCR-III mock-up.

21460 (HW–65550) **Use of control charts for analysis of plant rupture experience.** Bloomstrand, R.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Jun 1960. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010968. Source: OSTI; NTIS; GPO Dep.

Declassified.

Goal exposure and power level planning and administration on either a short-term or long-term basis, is heavily dependent upon assessment of the level of metal performance. It is the purpose of this document to present a method of monitoring the metal performance level employing the concept of control charts, and to propose adoption of this method as the basis for detecting changes in the metal performance level of the three main types of production fuel elements, i.e., C-II-N, O-II-N, and K-III-N material. Supplemented with predetermined decision rules for evaluating the extent to which the metal performance level has improved or declined, these control charts become valuable tools for use in making IPD operating decisions.

21461 (HW–65598) **Coincident pressure and stress data obtained from PT-278-A and PT-301-I.** Hawley, J.P.; Adams, O.E.; Jones, S.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 May 1960. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010981. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document presents experimental data obtained during a series of tests which were completed at 105-D and DR Reactors in February and March, 1960. No analysis of the data is included in this document. The tests were: PT-301-I, II – Reactor cold, full flow, BPA power failure; PT-278-A, III B – 1170 MW, full flow, BPA power failure; and PT-278-A, II – 1190 MW, full flow, poison push causing bulk surge and scram.

21462 (HW–65721) **Provisional process specifications for the attachment of support rails by electrical resistance spot welding.** Padgett, E.V. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jun 1960. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010948. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents provisional specifications for the modifications and additions to the Lead Dip Canning Process for Heat Treated Uranium for the production test fabrication of projection fuel elements by resistance spot welding.

21463 (HW–65754) **Final report on program for using X-8001 aluminum alloy cladding material for Hanford fuel elements: PT-IP-43-A-84-MT, IP-80-A-91-FP and IP-2-I-99-FP.** Hodgson, W.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jul 1960. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011319. Source: OSTI; NTIS; GPO Dep.

Declassified.

Use of X-8001 Al alloy as cladding for Hanford reactors was initiated because of superior (laboratory) resistance to intergranular corrosion over that of C-64 alloy. However, since severe pitting attack was observed intermittently, an evaluation was carried out on X-8001 alloy fuel element cladding.

21464 (HW–65759) **Proposed solid state diffusion bonding (SSDB) process: Gas pressure bonding.** Weakley, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jun 1960. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010950. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents a technical and economic study of the lead-dip canning process compared to two types of solid state diffusion bonding processes (hot-press die and gas pressure bonding) for Hanford production fuel elements (exclusive of NPR). It is concluded that either bonding process has potential advantages over the lead-dip process. The gas pressure bonding process has advantages over the hot-press die process.

21465 (HW–66083) **Significance of operating experience with poison splines at KE Reactor.** Franklin, F.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1960. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011272. Source: OSTI; NTIS; GPO Dep.

Declassified.

The demonstrated operating efficiency performance which has resulted from poison spline usage forces an economic decision concerning the self-supported and bumper fuel element programs. As originally conceived the projection fuel elements would preclude

the insertion of a spline under the fuel charge; thus it is very important that means be devised either to make poison spline usage compatible with future pile loadings or to demonstrate that some other supplementary control system, which is compatible with future pile loadings, can approximate the effect the splines have an operating efficiency. This report shows the appreciable performance improvement which has been achieved at KE Reactor through the application of the poison spline system.

21466 (HW–66106) **Radiometallurgical examination of 1.47 enriched I&E fuel elements for PT-IP-247-A.** Teats, R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Jul 1960. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010987. Source: OSTI; NTIS; GPO Dep.

Declassified.

Under the conditions of PT-IP-247-A, four columns of self-supported and four columns of rib-supported I&E 1.47% enriched fuel elements were irradiated to determine their relative performance under severe operating conditions. Four of the self-supported and two of the rib-supported control elements were received for nation. The two rib-supported control pieces, which were classified as "near failures" had received average exposures of 353 and 359 MWD/T at average specific power levels of 91 and 108 KW/ft before they were discharged because of other ruptured pieces in the tubes. The nominal specified canned fuel dimensions of the rib supported elements was 1.445 in. OD, .310 in bore, and 7.640 in. long. The first two self-supported elements were selected for examination on the basis of high weight losses sustained during irradiation, and the second two were selected to determine the effect of specific power levels on the AlSi bonding. The average specific power levels of the four self-supported elements varied from 79 to 110 KW/ft and the exposure varied from 845 MWD/T to 949 MWD/T. The nominal canned dimensions of the self-supported elements, which were made oversize to attain high annular coolant temperatures with respect to the interior coolant channel, were 1.460 in. OD, .375 in. bore, and 7.640 in. long. The eight bridge rail supports were spot welded on and gave an effective rib outside diameter of 1.600 in. All of the components were X-8001 aluminum alloy.

21467 (HW–66135) **KER-3 Operating Report: Test No. K-3-10 -PT-IP 288-A, Test No. K-3-11 -PT-IP-317-A -PT-IP-315-A.** Sharp, F.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Jul 1960. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012830. Source: OSTI; NTIS; GPO Dep.

Declassified.

The loop was charged October 30, 1959 with seven 12-inch Natural Uranium Zircaloy-2 clad 7-rod clusters. The test was primarily for the new hot-headed method of end closure used on these elements. The loop was pressure tested at 4000 psi after it was charged. Initially the loop was held at low-temperature to study the buildup of oxygen (presumably from radiolytic decomposition of water). After startup the neutron activity held at slightly above normal but the strainer gamma activity was exceptionally low. Frequent additions of LiOH bombs were necessary to maintain the pH at 10.0 (previously it was 4–5 pH but was raised to pH 10 for this test.) After the temperature was raised to operating conditions the pH held nicely at 10. On November 16, 1959, the heat exchanger exit temperature thermocouple blew out resulting in depressurization of the loop and a reactor scram. Repairs were made during the outage and the loop was returned to normal operation. Eleven scrams occurred during the test period caused by 105-KE or 1706-KER.

21468 (HW–66242) **Program for crud and corrosion studies for proposed Hanford reactor conditions.** Richman, R.B.; Dickinson, D.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Sep 1960. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011268. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents a proposed test program to study the corrosion of aluminum-clad fuel elements under conditions expected at the more severe conditions which will be encountered in operating the present Hanford reactor at higher power levels.

21469 (HW–66267) **Testing of Zircaloy-2-clad uranium seven-rod fuel elements: Final report.** Geering, G.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Jul 1960. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011991. Source: OSTI; NTIS; GPO Dep.

Declassified.

In 1955 the Fuels Development Operation began irradiation testing of fuel elements in high temperature water. It was assumed that if a new reactor were built at Hanford, it would be cooled by high-temperature, pressurized water. Corrosion tests showed that aluminum-clad production fuel elements could not be used in high-temperature water. Therefore, while work to improve the resistance of aluminum to high-temperature water proceeded, the Fuel Design Operation began irradiation of stainless steel- and Zircaloy-2-clad fuel elements. During 1956 and 1957, stainless steel-clad elements were tested in the Materials Testing Reactor (MTR), Hanford H Reactor Loop, and the KE Reactor Recirculating (KER) Loops. During 1957, a coextrusion method for cladding uranium rods with Zircaloy-2 was developed. The first irradiation of Zircaloy-2-clad fuel from an off-site supplier began in late 1958. The objective of the irradiation was to study the dimensional stability of the fuel rods and a seven-rod fuel assembly. Two coextruded, seven-rod elements were irradiated in KER Loop I.

21470 (HW–66334-RD) **Preliminary design basis modifications for improved coolant backup 100-B, D, F, H, DR, and C areas.** Schack, M.H.; Tupper, W.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Aug 1960. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010600. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this document is to establish the design scope for the proposed modifications to the reactor "last ditch" cooling systems in the 100-B, D, F, H, DR, and C Areas. The objective in making these modifications is to provide adequate "last-ditch" reactor coolant flows for safety of operation at power levels currently programmed for the period CY 1964 when additional "last-ditch" cooling facilities are planned in connection with major plant modifications. Additional interim modifications may be required for the last ditch system at the 100-C and DR Areas and for the export water system prior to major plant modifications during CY 1964–1965.

21471 (HW–66989) **Numerical results of production test IP-326-I, Low-flow calibration tests at B, D, F, and H Reactors.** Benson, J.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Oct 1960. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011108. Source: OSTI; NTIS; GPO Dep.

Declassified.

Recent reviews of the last-ditch water backup system at the old reactors had shown that complete adequacy could not be demonstrated at all of the reactors under all conditions. However, these conclusions were based in part on conservative calculations using basic data with a sizeable amount of possible error. Subsequently, recommendations were made to run several tests which would increase the accuracy of the basic data and thereby allow an increase in the demonstratable level of last-ditch vater backup adequacy. The water supply capabilities of the last-ditch system are normally measured with a tripout test where reactor riser pressures are recorded over a period of time while the reactor vater supply is transferred to the last-ditch system. These riser pressure readings are then converted to reactor flows later by means of a reactor hydraulic demand curve, so the inaccuracy in the low-flow region of these curves result in an inaccurate assessment of the water flow obtained from the last-ditch system during the tripout test. The purpose of this document is to report the results of the aforementioned low-flow calibration tests at B, D, F, and H Reactors.

21472 (HW–67145) **Irradiation test data for holder No. 2 development test IP-295-D the irradiation of candidate PRTR**

gas loop materials HAPO 237. Marshall, R.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Oct 1960. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012694. Source: OSTI; NTIS; GPO Dep.

Declassified.

The test was located in the C Reactor. Reactor atmosphere analyses are given. Graphite temperature near the holder was about 500 C at equilibrium operation.

21473 (HW–67168) **Production test IP-363-A irradiation of ZR-2 jacketed enriched single tube fuel elements in the KER loops.** Kratzer, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Oct 1960. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012438. Source: OSTI; NTIS; GPO Dep.

Declassified.

The objective of this production test is to evaluate the behavior during irradiation of nominally 1.739 inch OD., 1.074 inch ID., Zircaloy-2 jacketed single tube fuel elements with brazed end closures at operating conditions somewhat more severe than those expected for N Reactor fuel element outer tubes. Enriched single tube elements with brazed end closures and modified fuel element supports are authorized for irradiation in the KEG loops to an exposure no higher than 4000 MWD/T. A typical loading and set of operating conditions are given; these may be modified, however, by obtaining appropriate approvals.

21474 (HW–67207) **Production test IP-372-K uranium discharging during operation KE reactor.** Frantz, C.E.; Carlson, P.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Oct 1960. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012435. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this test is threehold; to test the workability of the flapper and/or ball cap – actuator combination under reactor operating conditions to determine the effect on the K Reactor operating parameters of the rapid discharge of a column of slugs; and to ascertain the radiation levels present at various locations in the 105 Building when a column of irradiated slugs is discharged during operation.

21475 (HW–67207-Suppl.B) **Supplement B to production test IP-372-K, Uranium discharging during operation KE Reactor.** Frantz, C.E.; Carlson, P.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 May 1961. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012434. Source: OSTI; NTIS; GPO Dep.

Declassified.

The original test authorized the discharge of three columns of irradiated fuel elements from KE Reactor as a first step in an Operational Recharging program. Purpose of this supplement is to authorize discharge of any number of columns of irradiated fuel elements after shutdown, and to continue in force Supplement A, with changed timing of operational discharge.

21476 (HW–67208) **Technical bases for C-pile overbore test.** Curtiss, D.H.; Clinton, M.A.; Nechodom, W.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Nov 1960. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012433. Source: OSTI; NTIS; GPO Dep.

Declassified.

The production gains and economic evaluation of overboring has been extensively treated. In this document, the justification for a trial attempt at overboring C-Reactor was given. The overboring test, covered by two production tests (one or overboring and one for fuel irradiation), requires the integration of efforts of Equipment Development, Process and Reactor Development, Process Technology, Manufacturing, and the Fuels Preparation Department. In view of this, it appears prudent to collect in one place the current design numbers with a word of explanation regarding their derivation. To this end, this document is dedicated.

21477 (HW–67264) **Proposal for the irradiation of cladding studies capsules.** Weber, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Nov 1960. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010496. Source: OSTI; NTIS; GPO Dep.

Declassified.

In irradiations of rod cluster and tubular fuel elements and fuels rods in NaK-filled capsules, the Zircaloy-2 cladding has failed by necking in localized region. Purpose of the proposed tests to to help establish cladding thickness tolerances for NPR fuel elements, and to study the failure mechanism and influence of several variables.

21478 (HW–67627) **Possible causes of accelerated corrosion in the KER 1 loop.** Dillon, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Nov 1960. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012417. Source: OSTI; NTIS; GPO Dep.

Declassified.

The KER-1 Zircaloy process tube extracted from the reactor in May 1960, is currently being examined in Radiometallurgy with particular attention to an area of heavy oxidation and hydriding revealed during a burst test. The area in question is approximately 1 1/4in. wide and extends longitudinally an unknown distance from the points where sections have been taken. The oxide layer of interest is about 8 mils thick at the center, thinning at the edges. The "oxide" is quite adherent with only relatively minor systems of longitudinal cracks observed. There is no corresponding thick oxide on the outer surface of the tube. The hydride region decreases from an estimated 1000 to 2000 ppM at the oxide-metal interface to about 30 ppM at the outer surface. Assuming a linear concentration gradient, the average hydrogen content in the affected zone might be about 750 ppM (Examination of the metal at the midpoint of the tube section suggests 750 ppM is-probably excessive). The region of high hydride concentration extends circumferentially past the heavily "oxidized" region, presumably because both tube temperature and hydride concentration gradients are favorable to hydrogen diffusion.

21479 (HW–67713) **Rear-face Parker fitting reaming.** Brinkman, L.B.; Corley, J.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Dec 1960. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012416. Source: OSTI; NTIS; GPO Dep.

Declassified.

Although a fuel reactor job procedure has not yet been prepared, techniques and equipment used in a current production test are adequate with minor modifications for full reactor Parker fitting reaming. With existing reactor hardware, available flow increases at B, D, and F Reactors would be limited to about 2,500 gpm. The extent of additional rear face piping problems which may be encountered as a result of reaming cannot in several instances be predicted with confidence at this time. It is expected that preliminary answers to currently foreseen problems will be available by April 1, 1961. To some extent, however, this is dependent on production tests under way or proposed, and will require coordination with various Manufacturing Operations. For vibration and flow problems in the downcomer approach piping, conclusive answers may not be available before July, 196l, although there is no positive evidence that the flow increases cannot be absorbed. Increased pressurization of effluent line junction boxes at 105-D has been solved by improved box venting. Increased flows resulting from reaming may require still greater venting capacity, which would be available for capital expenditures on the order of $3,000–$5,000 per area.

21480 (HW–67728-Pt.2) **B-Plant fission product flowsheets: Part 2.** Rey, G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Sep 1961. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012955. Source: OSTI; NTIS; GPO Dep.

Declassified.

The technical bases for Phase I of the Fission Product Program have previously been presented for Phase I design. This report represents its sequel for Phase II of the program. Phase I provides the means of segregating, concentrating, and aging crude fission product fractions with market value. Phase II is to provide the means for single-line purification and packaging of megacurie quantities of fission products (principally strontium-90). The technical bases for Phase II project scoping studies are presented herein in the form of process flowsheets and tabulated data. Equipment needs are also described. Conceptual processes and flow diagrams for Phase III are presented for the Waste Management Program and the Fission Product Program.

21481 (HW–67955) **KER-4 operating report test K-4-8, PT-IP-300-A.** Young, K.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Dec 1960. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010867. Source: OSTI; NTIS; GPO Dep.

Declassified.

Objective of the test was to determine and evaluate the behavior of 8 20-inch fuel elements during irradiation using the hot-headed end closures on the inner tube.

21482 (HW–67970) **PT-IP-385-C, E-N reactivity matching measurement.** Carter, R.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Dec 1960. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010868. Source: OSTI; NTIS; GPO Dep.

Declassified.

The projected E-N load at H Reactor will require a complete change in the type of charge placed in most flattened zone process tubes. Objective of this test is to determine the reactivity of the proposed E-N charge relative to the known natural uranium charge reactivity.

21483 (HW–68066) **Conversion ratio consideration in the E-N fringe loading.** Bowers, C.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Jan 1961. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012415. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document summarizes the requested study of theoretical factors influencing the expected conversion ratio of the fringe enrichment portion of an E-N loading. Exact calculation of the quantity is very complicated and will not be attempted here; however, it is possible, with simple geometric approximations, to derive relative conversion ratios. This present report summarizes the results of a study incorporating actual operating data from the present poisoned top and unpoisoned bottom fringe loadings at H Reactor. There is calculated decrease in buckled-zone (E-metal blanket) conversion ratio of 13% in the E-N loading as compared to normal fringe loadings; this loss is due to the effective reduction in pile size due to the presence of the blanket of BOLL material in the outermost lattice unit and the accompanying increase in enrichment demands. On a full pile basis, this loss represents about 5%. However, on the assumption that an atom of tritium is equivalent in value to an atom of plutonium, the BOLL material in the outermost layer augments over-all pile conversion by about 4% in the green reactor, and probably more in the ripe reactor in addition to compensating the 5% loss in the E-metal blanket. An Appendix is included as a possible help in interpreting conversion ratio observations in fringe E-columns.

21484 (HW–68101) **100-K Area Downcomer Test Data Project CGI-883.** Hutton, P.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Jan 1961. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012684. Source: OSTI; NTIS; GPO Dep.

Declassified.

105-KE downcomer pressure data are tabulated.

21485 (HW–68134) **Production test IP-387-D: irradiation service request HAPO 255; irradiation of cobalt in the KW bottom front-to-rear Magazine facility.** DeMers, A.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Jan 1961. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010926. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/testing; COBALT 60/production; HTGR TYPE REACTORS/research programs; GAMMA RADIATION; IRRADIATION; TESTING; PRODUCTION; RADIATION EFFECTS

21486 (HW–68176) **Fuel performance comparison old reactors, March 1960–December 1960.** Bloomstrand, R.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Jan 1961. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012683. Source: OSTI; NTIS; GPO Dep.

Declassified.

In relation to evaluation of the block discharge mode of operation, data for comparison of fuel rupture performance of the old reactors have been assembled, and are transmitted herein. We have analyzed these data and the results are also transmitted in this report. Based on analysis of rupture experience from March through December, 1960, adjusted for differences in power, temperature, exposure, and throughput, there are no significant differences in fuel rupture performance between the old reactors. This statement does not imply that there are no differences in economic performance between reactors. Differences of this nature cannot be judged solely from the data of this report.

21487 (HW–68197) **Simplified plutonium conversion expression.** Jensen, R.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Jan 1961. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010873. Source: OSTI; NTIS; GPO Dep.

Declassified.

An accurate, simplified expression relating Pu conversion to exposure, was found which could be substituted for the lengthy subroutine used to calculate conversions in the Process Optimization Program.

21488 (HW–68674) **IPD predicted vs CPD measurement differences twelve two-ton test batches.** Hoba, D.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Mar 1961. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010544. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report summarizes the IPD predicted vs. CPD measured values from twelve two-ton test batches. Two sets of comparisons are provided: CPD measured vs. IPD predicated based on techniques used since January 1, 1960 and CPD measured vs. IPD predicted based on techniques used prior to January 1, 1960.

21489 (HW–68737) **Re-evaluation of metal performance levels of C-II-N and C-II-E material.** Bloomstrand, R.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Mar 1961. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010618. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents an analysis of rupture experience at C Reactor over the past two years. The purpose of the study was to provide a basis for revising, if necessary, the current metal performance level multipliers for C-II-N and C-II-E material.

21490 (HW–68970) **Production test IP-402-A, irradiation of Zr-2 cladding studies capsules.** Kratzer, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Mar 1961. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010939. Source: OSTI; NTIS; GPO Dep.

Declassified.

The objective of this production test was to evaluate the effects of Zr-2 jacket uniformity, thickness, and temperature on non-uniform clad straining. Test details are provided.

21491 (HW–69085) **Fuels Development Operation quarterly progress report, July– September 1960.** Cadwell, J.J.; Tobin, J.C.; Last, G.A.; Evans, E.A.; Minor, J.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1960. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012952. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details activities of the Fuels Development Operation during the months of July, August, and September 1960.

21492 (HW–69088) **Loading and operating conditions for PT-IP-401-A and PT-IP-363-A in KER-1.** Kratzer, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Apr 1961. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011101. Source: OSTI; NTIS; GPO Dep.

Declassified.

IP-401-A authorized the irradiation of 18-inch UO_2 elements and IP-363-A authorized 18-inch KSE-3 elements. This document provides specific loading and operating conditions for a charge of one UO_2 element and two KSE-3 elements in KER-1.

21493 (HW–69173-RD) **Proposal for charging GEH-10-43 NINI interim measurement test in the ETR.** Geering, G.T.; Heck, E.N. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Apr 1961. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012529. Source: OSTI; NTIS; GPO Dep.

Declassified.

The objective of this test is to irradiate an NPR fuel element inner tube in the ETR 3 x 3 Loop. the NPR fuel element is a tube in tube type. Both tubes are Zircaloy-2 clad uranium metal. The inner tube is identified by the Hanford designation NINI. In GEH-10-43 we plan to measure an NINI tube after each cycle for four cycles. An NPR inner tube with slightly larger diameter has been run in the ETR Hanford 3 x 3 Loop. Two NINI elements are now running in the 3 x 3 Loop.

21494 (HW–69202) **Process water flow tests, C Reactor.** Hamilton, W.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Apr 1961. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010954. Source: OSTI; NTIS; GPO Dep.

Declassified.

The power calculator at C Reactor and the process pump flowmeters at 190-C use orifice plates as primary sensing elements. These orifices were designed for considerably less flow and at the present higher flows, the reactor riser pressure is appreciably reduced as the result of the inefficiency of the orifices. Only a portion of the differential pressure across an orifice is recovered. The amount is dependent upon the ratio of the orifice diameter to pipe diameter. The permanent loss across these two orifices is 16 psi. The permanent pressure loss resulting from properly sized venturi elements would be 1.6 psi, for a resultant decrease in system pumping resistance of 14 to 15 psi. This would permit higher process water flow and reactor power levels.

21495 (HW–69365) **Revision to optimization constants.** Newell, L.J.; Spencer, H.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 25 Apr 1961. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010938. Source: OSTI; NTIS; GPO Dep.

Declassified.

Tables are given for revised constants in the optimization model for charge-discharge rates, tube replacement rate, non-power-exposure- associated loss (EMISC), hours lost per rupture, and ruptured slug removal time in the reactors B, C, D, DR, F, H, KE, and KW.

21496 (HW–69378) **Supplement G, production test IP-314-A, measurement of fuel element temperature changes as the result of film deposition.** Kratzer, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 25 Apr 1961. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010937. Source: OSTI; NTIS; GPO Dep.

Declassified.

Irradiation of a third thermocouple train with a thermocouple element of the same design as used on the previous two trains, but with different train design and heater elements, is authorized to an exposure no greater than 1000 MWD/T. A third decontamination of KER-1 is also authorized.

21497 (HW–69419) **Physics data for proposed HAPO H-1 loop irradiation.** Franklin, F.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Apr 1961. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010936. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides data for the proposed HAPO H-1 Loop irradiation testing.

21498 (HW–69552) **Accountability equations for plutonium and tritium yields for PT-IP-305-C at 105-H.** Nechodom, W.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 May 1961. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010475. Source: OSTI; NTIS; GPO Dep.

Declassified.

It is necessary to provide accountability tables and equations for use in routine product buildup predictions for the duration of the E-N and blanket loads charged under PT-IP-350-C. Recommended values are given.

21499 (HW–69717) **C-Reactor graphite burnout interim report, 1P-25A(PT-105-532-E).** Ryan, B.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 5 Apr 1961. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013495. Source: OSTI; NTIS; GPO Dep.

Declassified.

The oxidation of graphite in the Hanford reactors is of consequence since graphite burnout affects the strength of the moderator. As a means for indication of any highly oxidizing condition within the stack, containers or boats of small weighed samples of reactor-grade graphite are positioned along the length of an empty process channel in each reactor. The rate of oxidation of the monitoring samples, referred to as the burnout rate, is reported as percent weight lose per 1000 operating days (%/KOD). Currently the burnout rate limit is 2%/KOD. This document presents recent burnout data at the C-reactor.

21500 (HW–69941) **Coextrusion process specifications.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. Aug 1961. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012084. Source: OSTI; NTIS; GPO Dep.

Declassified.

These specifications, prepared for the N-reactor fuel, provide the framework on which the overall control and guidance of the manufacturing process shall be built.

21501 (HW–69999) **Planned normalization of plutonium yield predictions to the twelve two-ton test batch measurements.** Hoba, D.W.; Vaughn, A.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Jun 1961. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012096. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report is a comparison of findings from the twelve two-ton test batches irradiated in the KE and H reactors with respect to

reactor plutonium yield predictions. Included are plans for the application of these findings to improve the accuracy of plutonium yield equations used for Hanford product accountability.

21502 (HW–70128) **Process tube expansion: 105-C conversion to self-supported fuel elements.** Mollerus, F.J. Jr. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Aug 1961. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011258. Source: OSTI; NTIS; GPO Dep.

Declassified.

A method of reducing gas leakage and rear fate maintenance is to fix the rear gunbarrel and process tube to the shield and eliminate the need for a rear expansion bellows. This arrangement is being considered as part of the C-reactor conversion to self-supported fuel element program. The fixed rear gunbarrel will require that all hydraulic load and thermal expansion elongation of the tube be taken through the front bellows. In the event that tubes freeze in their channels, forces due to thermal expansion and hydraulic pressure will be transmitted to the rear shield if the tube and rear gunbarrel are fixed to the shield. Calculated maximum forces which can be transmitted to the shield are given in this report. The probability and amount of restraint which can occur in the tube are discussed. Finally, methods of insuring that the restraint does not cause excessive forces on the rear shield are discussed.

21503 (HW–70137) **Analysis of radiation induced stresses in C Reactor graphite.** Yoshikawa, H.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Aug 1961. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010951. Source: OSTI; NTIS; GPO Dep.

Declassified.

Figures are included which gives the necessary information on C Reactor for analysis of stress buildup in the graphite tube blocks.

21504 (HW–70198) **Analog simulation of VSR withdrawal rates.** Nilson, R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Jul 1961. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010945. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/ reactor kinetics; TRANSIENTS; REACTOR START-UP; CONTROL ELEMENTS; REACTIVITY; MATHEMATICAL MODELS

21505 (HW–70295) **Process improvement transition authorization IP-17-AI, reduction of the amount of dichromate added to process water.** Nesselson, E.J.; Shimer, R.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jul 1961. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012103. Source: OSTI; NTIS; GPO Dep.

Declassified.

This PITA is designed to permit large-scale application of a change in process water inhibitor concentration before a permanent change to the Water Plant – Process Standards is fully justified and implemented. Specifically, this PITA authorizes reducing process water dichromate concentration to 1.0 ppm at all reactors (C excluded), provided pH remains at 7.0 ± .1.

21506 (HW–70557) **Fuels Development Operation quarterly progress report, April–June 1961.** Cadwell, J.J.; Tobin, J.C.; Last, G.A.; Evans, E.A.; Minor, J.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1961. 134p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011989. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details activities of the Fuels Development Operation for the months of April, May, and June 1961.

21507 (HW–70697) **Ultrasonic and resistance welding of ZR supports to ZR fuel element cladding.** Steinkamp, W.I. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Aug 1961. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012548. Source: OSTI; NTIS; GPO Dep.

Declassified.

Tube-tube type fuel elements require support devices to maintain concentricity both between the element components and between element and process tube. A variety of support devices have been conceived. all require welding of a tab or other attachment device to the Zircaloy clad. Ultrasonic and resistance welding were evaluated for this application. Investigation showed ultrasonic welding to be not acceptable in its present state. Resistance welding proved satisfactory. This paper will briefly cover the work done in evaluating the two methods of attachment.

21508 (HW–70708) **Current status of H Reactor total control.** Vaughn, A.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1961. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011299. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document presents the total control aspects of the current blanket and central zone E-N loading at H Reactor based on the calculational parameters in Physics of E-N Load compared to Natural Uranium Load at H Reactor, D.I. Monnie, May 11, 1961. The original charge for the E-N core load at H Reactor, (19.37 in. E to 1 in. N) was found to be more reactive than desirable for maximum production efficiency. Therefore a less reactive E to N ratio (18.14 in. E to 1 in. N) has now replaced the original loading.

21509 (HW–70740) **Recommended E-N charge modification (Second cycle PT-IP-350-C E-N demonstration load).** Carter, R.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Aug 1961. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010538. Source: OSTI; NTIS; GPO Dep.

Declassified.

The original charge for the E-N core load at H reactor, consisting of five different types of charges, each group of five containing 199 .947 per cent enriched uranium E-pieces of six inch nominal length and 16 Li-Al I&E (N) pieces of four inch nominal length plus mixers, was intended to provide enough excess reactivity to operate the reactor at all times with reasonable but not excessive flexibility. During actual operation the excess reactivity observed has been somewhat greater than conservatively planned. In addition, a very slight long-term gain rather than the expected loss has been observed up to this time (73 MWD/column average exposure). On this basis, a modification of the original charge makeup has been determined which will permit increased conversion and operating efficiency.

21510 (HW–70778) **Radiochemistry for the rupture of a Zircaloy-2 clad thermocoupled fuel element in KER Loop-1 on May 12, 1961.** Perrigo, L.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Aug 1961. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010574. Source: OSTI; NTIS; GPO Dep.

Declassified.

On the 1600–2400 shift, May 12, 1961, the delayed neutron monitor on KER Loop 1 gave a high coolant activity signal indicating a possible fuel element failure in this loop. KE Reactor was shut down immediately thereafter. This report is being written to summarize the events pertinent to the KE Reactor scram and to discuss the results and significance of data from the analyses of coolant samples taken from the KER Loop-1 System.

21511 (HW–71003) **Power calculation accuracy with dual downcomer operation.** Renberger, D.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Sep 1961. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010534. Source: OSTI; NTIS; GPO Dep.

Declassified.

The C reactor is presently, operating with all process water discharging through one downcomer. Pressure measurements at the

downcomer lid show the top tray is nearly flooded, thus prohibiting further flow increases until the downcomer is modified or both downcomers are used simultaneously. Operation with two downcomers can result in two sources of error in the power calculation: (1) Errors in measured outlet temperature can occur, apparently due to the increased venting capacity. The magnitude of the effect is probably unpredictable and could not be compensated for in the power calculation. Since the temperature error occurs only downstream of the downcomer vents, the logical solution is to move the outlet temperature devices to the risers. The method of administering bulk temperature limits will have to be changed to account for the thermal shield flow entering downstream of the outlet thermohms. (2) Simultaneous flow and temperature unbalances can result in power calculation errors since there is no way of knowing the actual flow through each downcomer. It is assumed that the power calculation would have to be made from the total flow and the average of the two outlet temperatures. The primary purpose of this study was to determine whether the power calculation errors due to flow and temperature unbalances would be significant.

21512 (HW–71075) **Results of Laboratory Heat Transfer experiments for C-reactor overbore fuel channels.** Waters, E.D.; Kreiter, M.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Nov 1961. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012010. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to present experimental data concerning the heat transfer and fluid flow conditions within a C-overbore geometry process channel for the cases of steady state operation, flow plugging incidents, and inlet piping failure incidents.

21513 (HW–72345) **NPR Physics Startup Testing Program.** Bowers, C.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 25 Apr 1962. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013505. Source: OSTI; NTIS; GPO Dep.

Declassified.

The New Production Reactor, as compared to existing Hanford reactors, employs new and unique design concepts. To properly evaluate these design concepts and their effects on reactor operations, nuclear safety, and reactor life, a comprehensive testing program is planned; this program, with its objectives and restrictions, is discussed in this report. It has been developed along the same line as the C and K Reactors test, programs, and is expected to require a total time of 6–8 weeks of round-the-clock testing. This estimate includes fuel loading time, but does not include time allotments for engineering acceptance tests prior to power operation nor does it include any of the time necessary for engineering and physics tests during the extensive power ascension program. The main body of this report is presented in three parts. The first section describes startup hazards and restrictions, reactor and component safety provisions prior to loading, and the itemized listing of quantities to be measured. The second includes preliminary material and plant conditions and a brief description of the individual tests. The third section (the Appendix), written in procedure language, comprises a rather detailed description of each individual test on a tentative basis; final test details and procedures, which will lie within the boundaries authorized by this document wil1 be established through joint efforts of Operational Physics and NPR Operations sub-section personnel.

21514 (HW–72366) **Rear face piping study at elevated bulk outlet temperature: KE Reactor.** Frieling, D.H.; Hutton, P.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Jan 1962. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012551. Source: OSTI; NTIS; GPO Dep.

Declassified.

The work described in this report was authorized under Development Test IP-419-E. The primary objective of this study was to establish the stress, hydraulic and vibration conditions which exist in KE Reactor rear face piping components under maximum presently authorized operating conditions and evaluate these conditions from the standpoint of continuity of reactor operation. Test data were recorded at various levels of operation up to and including the maximum authorized bulk outlet temperature. The data recorded during this test were used to establish model conditions for Project OGI-883. With model conditions established, additional tests will be conducted to explore the possibility of operating the reactor in regions above the present limiting bulk outlet temperatures. The test, as outlined in the development tests document, has been conducted and the pressure, temperature, vibration, and stress data has been tabularly and graphically compiled. Indicated hydraulic conditions have been substantiated theoretically with reasonable accuracy. A drawing indicating the instrumentation locations is provided in Appendix IV of this report.

21515 (HW–72855) **Reactivity and efficiency trends vs operating trends for B, D, DR, and F reactors, 1956–1960.** Perl, E.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Mar 1962. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010532. Source: OSTI; NTIS; GPO Dep.

Daclassified.

Changes in operation and corresponding changes in the reactivity status of Hanford reactors are the result of a continuing effort to improve operating efficiency. Trends data related to these changes in operation and reactivity have been published previously for the periods from 1955 through 1959. The purpose of this report is to include trends data for 1960. Bar graphs in the first part of the report show yearly averages of selected data, and the line graphs in the second part show the interrelationship of some of the yearly averages depicted in the first part. The tables in Appendix I show maximum, average, and minimum values. This document presents trends data for B, D, DR, and F reactors, while a second document, HW-72856, presents trends data for C, H, KE, and KW reactors.

21516 (HW–73154) **Relocation of radial enrichment at the K reactors to decrease enrichment inventory.** Kosmata, A.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Mar 1962. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011318. Source: OSTI; NTIS; GPO Dep.

Declassified.

The enrichment inventory required in the Hanford reactors is greatly dependent on the location of the radial enrichment ring. Present and past philosophy has dictated that the radial enrichment be located as close to the periphery of the reactors as possible, consistent with total control criteria, to obtain maximum flattening efficiency. As long as individual tube power limits dictate total pile power this philosophy of maximum flattening is consistent with a goal of maximum production. For the past year the total pile power at the K reactors has been restricted by bulk outlet water temperature limit or administrative total power level limits. During this time fuel ruptures have been negligible due to improved metal quality and axial flux shaping. If present operating conditions continue the relocation of the enrichment ring could be desirable to decrease the enrichment inventory. Moving the radial enrichment toward the center of the reactor to decrease the inventory would result in lower flattening efficiency and require higher tube power limits for the same total pile power level.

21517 (HW–73275) **Irradiation effects on nuclear fuel elements in the Hanford reactors.** Hagie, L.T.; Jaech, J.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. May 1962. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011996. Source: OSTI; NTIS; GPO Dep.

Declassified.

A study of irradiation effects on normal Hanford AlSi-canned I&E fuels was started in March, 1959 under the name of the Quality Certification Program. This report describes the irradiation-induced effects for Warp, Tube Filling Capacity, changes in Outside Diameter, Profile Types and Break Strength, in terms of mathematical models as functions of reactor power, time, and temperature. Graphical representation of the response surfaces generated by

these models are included. Future Quality Certification programs are presented.

21518 (HW–73483-SUP.1) **Scram recovery data preceding "C" overbore fuel failures.** Wood, S.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1962. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012101. Source: OSTI; NTIS; GPO Dep.

Declassified.

Considerable interest has been generated concerning the recent series of overbore fuel failures at C Reactor. It therefore is appropriate to document the operating conditions which existed prior to the failures. This report presents a chronological description of events leading up to the failures, and graphs and tables of various pertinent parameters.

21519 (HW–73580) **C reactor overbore fuel failures.** Ambrose, T.W.; Graves, S.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Apr 1962. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012004. Source: OSTI; NTIS; GPO Dep.

Declassified.

The concept of overboring the graphite channels in an older Hanford reactor and installing oversized tubes charged with oversize fuel elements is being investigated at C reactor. Recently a column of these oversized test fuel elements exhibited three uranium cleavage (split) type failures after experiencing severe reactor flux cycling. This report presents a preliminary description of both the fuel failures and the flux cycling encountered by the reactor.

21520 (HW–73615) **Technical evaluation of E-N demonstration loading: (Interim report, production test IP-350-C).** Carter, R.D.; Nechodom, W.S.; Shimer, R.D.; Fullmer, G.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 May 1962. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012005. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents the technical observations and conclusions to date of the full-reactor demonstration E-N loading for the combined production of plutonium and tritium. A major incentive for such a loading is the increase in conversion ratio resulting from three factors: (1) A "blacker" lattice,, in which a combination of "E" metal fuel elements (uranium enriched to 0.95% U^{235}) and "N" metal target elements (enriched lithium-aluminum alloy) approximately matches the reactivity properties of a natural uranium lattice, results in a smaller proportion of parasitic capture of neutrons in the moderator and other reactor components. (2) The capture of neutrons in fringe target material results in the formation of useful product by a significant fraction of the neutrons otherwise lost by leakage. (3) The burnout of product atoms (plutonium and tritium) is reduced in the blacker E-N lattice, thereby increasing the net yield of product atoms per MWD of heat generation compared to the natural loading. Potential advantages for plant-wide E-N production include the routine processing of a single metal stream for Hanford, increased product quality at reduced throughput, and increased production and recovery of higher isotopes in recycled streams.

21521 (HW–73958) **Ruptured slug data, January 1, 1962–April 30, 1962.** Newell, L.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Jun 1962. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012016. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this document is to provide a tabulation of data concerning ruptured slugs for the use of various interested parties. This report presents data for the ruptures that occurred from January 1, 1962, through April 30, 1962, inclusive. Definitions of the terms used in the tabulations are nearly self-explanatory and are documented in the reference document. The possible exceptions to this are the three terms: type of metal, type of failure, and lot number. The legends currently in effect for these three terms are provided in this report.

21522 (HW–75327) **Reorificing proposal D Reactor.** Hollifield, P.J. Hanford Works, Richland, WA (United States). 19 Oct 1962. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011090. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/ reactor channels; REACTOR CHANNELS/pressure dependence; RECOMMENDATIONS; ORIFICES; FLUID FLOW; PRESSURE DROP; HYDRAULICS

21523 (HW–75417) **Economic analysis of 10-inch and 12-inch fuel element production for three separate conditions.** Grubb, F.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Jan 1963. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010615. Source: OSTI; NTIS; GPO Dep.

Declassified.

Three conditions representing various quantities of 10-inch and/ or 12-inch fuel elements were presented by the Industrial Engineering Group, IPD, as a basis for initial estimates of economic incentive to partially convert the Production Fuels Section AlSi process to longer fuel elements for FY 1964. An earlier study (Ref. 1) pertained to 10-inch instead of 6-inch enriched fuels. The comparatively larger quantities of the 4 in. longer fuel for full E-N loading showed a larger payout than for the requirements shown in this study. Since the estimates have been prepared without the benefit any process development or equipment design, the validity of the results of this study rest directly with the assumptions. These assumptions are itemized in some detail to explain the basis from which payout was calculated. At best, the study can be used as a preliminary estimate, subject to changes as more detailed analysis are made.

21524 (HW–75465-E) **Supplement A to production test IP-546-A irradiation of diffusion-bonded fuel elements.** Hladek, K.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Feb 1964. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010916. Source: OSTI; NTIS; GPO Dep.

Declassified.

The original test authorized the irradiation of about 20 fuel columns containing hot-die-sized, diffusion-bonded fuel elements. Objectives of this supplement are to permit irradiation of an additional ten columns of hot-die-sized, diffusion-bonded fuel elements, and to obtain data on the relation of the coolant temperature distribution and fuel element behavior. These fuel columns will be irradiated in smooth-bore Zircaloy-2 process tubes in the C Reactor.

21525 (HW–75493) **Review of reactor graphite distortion problems.** Coughren, K.D.; Kempf, F.J.; Munro, C.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Nov 1962. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011990. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this document is primarily to discuss the effects of current retubing programs on the graphite moderator of the K Reactors. A secondary purpose of this report is to present general information related to graphite arrangement and keying patterns at the other operating reactors and to review, in a limited way, the types of graphite distortion observed at these reactors.

21526 (HW–75542) **190-DR steam turbine backup adequacy report.** Radtke, W.H.; Keplinger, E.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Nov 1962. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011266. Source: OSTI; NTIS; GPO Dep.

Declassified.

Because of the questionable performance of the 190-DR steam backup system during the power outage of April 6, 1962, it is felt that a general review of the DR secondary water system capabilities and the standby status of the pumping units is warranted. This report shall briefly describe the performance of the steam backup system during the April 6 power outage and the subsequent power outage of July 10, 1962. Since the former outage, tests have been conducted on the steam pump units to determine their capabilities; the test results are presented in this report. A statement of the generally accepted criteria for secondary coolant system adequacy is included and recommendations for meeting the criteria at DR reactor are presented.

21527 (HW–75589) **K-Reactor Retubing Program graphite temperature study.** Agar, J.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Dec 1962. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012014. Source: OSTI; NTIS; GPO Dep.

Declassified.

A project has been proposed and the funds allocated for the replacement of the central zone aluminum process tubes at both K Reactors with smooth bore zirconium process tubes of approximately the same outside diameter as the original tubes. Associated with this project is the problem of relieving the present graphite stack distortion in the vicinity of the process tube channels and counteracting or prereliving, at this time, the expected graphite stack distortion that, will take place over the next ten years. Such relief becomes increasingly important when it is realized that long reactor life is required for the zirconium tubes in order to justify the cost of the project. This justification is also based upon the ability to charge normal sized, self supported fuel elements during the reactor life of the tubes. Relieving the restrictions in the graphite process channels caused by stack contraction will be done by removing localized portions of the graphite from the tube blocks and trunion blocks with a guided cutting tool. This immediately brings up the question of graphite temperatures and the presently imposed maximum graphite in temperature limits. Combined coring and graphite stark distortion could result in excessive graphite temperatures or localized hot spots. This graphite temperature study was undertaken to permit predicting possible temperature problems that might be associated with the restoration of graphite channel straightness since the timing of the overall project completion will not allow time for extensive testing to determine such problem areas.

21528 (HW–75607) **Production test IP-550-I: Routine monitoring for moderator oxidation rates.** Baars, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Apr 1963. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011997. Source: OSTI; NTIS; GPO Dep.

Declassified.

The objectives of this production test are: 1. To authorize the outage time involved in installing and removing oxidation monitors for the reactors, and 2. To specifically define sample design, spacing of samples in the channels, and residence times to insure adequate routine monitoring of moderator oxidation rates. This production test is concerned with B, C, D, F, DR, F, and H reactors. Similar requirements have been specified in PITA IP-20-I for KE and KW reactors.

21529 (HW–76060) **Contraction of graphite: A comparison of laboratory and production reactor data, Part 2, KE and KW Reactors.** Giberson, R.C.; Morgan, W.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Jan 1963. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011982. Source: OSTI; NTIS; GPO Dep.

Declassified.

Part 1 of this two-part report presented a comparison of the irradiation-induced contraction rates obtained on standard-size graphite samples and the apparent moderator contraction rates of H, DR and C Reactors. The distortion trends of the top center of the graphite stacks, from which the apparent moderator contraction rates were derived, were presented as a function of cumulative power generation since start-up for each of the six older Hanford reactors. Since KE and KW Reactors are of identical construction, different in many details from the six older reactors, and have been operated under similar conditions, the data from KE and KW are treated as if from one reactor. As in Part 1, contraction rates apply to measurements made transverse to the extrusion axis of the bars. As used in this report, the depression rates refer to the rate of reduction in height of the top center of the reactor moderators. This depression rate is the net effect of contraction and expansion of the graphite bars. The depression rate is used to calculate the contraction rate of the individual bars. The contraction rates derived from the reactor data are compared with contraction rates of small samples of the same graphite (TSGBF) as was used in the core of the K Reactors.

21530 (HW–76305) **Loading, operating conditions, and water shutoff times for a charge of twelve enriched single tube elements, PT-IP-544-A.** Kratzer, W.K.; Wise, M.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jan 1963. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012414. Source: OSTI; NTIS; GPO Dep.

Declassified.

This production test authorized the irradiation of 1.6% enriched single tube elements in KER-1 and 2. This document provides the process tube loading, operating limits, and water shutoff times for the charge.

21531 (HW–76509) **Final report PT IP-513-C recalibration of horizontal control rods at H Reactor.** Vaughn, A.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Feb 1963. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011316. Source: OSTI; NTIS; GPO Dep.

Declassified.

The control rod calibrations in the E-N core loading and in the natural uranium core with an E-N blanket yielded results which indicate that the controls are approximately 10 per cent less effective in an E-N core due to shadowing of the rod strength by the E-N lattice; it had been expected from theoretical, calculations that the E-N shadowing effect would be approximately 10 per cent. The tests thus indicate that there has been approximately 25 per effective rod calibration value since the 1957 calibration due to changes in the flux pattern associated with alterations in fuel type and geometry. The significant difference between the measurement made in 1957 when the loading was basically natural uranium, and the measurement made in November 196l, when the pile contained E-N fuel, is thus concluded to be a combination of the blacker lattice and flux distribution effects.

21532 (HW–76858) **Interim report on hot die sizing variables test.** Strand, C.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 May 1963. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011999. Source: OSTI; NTIS; GPO Dep.

Declassified.

Studies were initiated at Hanford in 1961 and 1962 toward the development of an alternate assembly process for the production of I&E fuel elements for the eight existing Hanford reactors. Of the processes considered, hot die sizing, a diffusion bonding process, offered the greatest incentives in terms of improved quality and potentially cheaper unit cost of fuel elements compared to the currently used AlSi braze process. This interim report presents the results of initial process variables tests designed to establish optimum process parameters for producing good diffusion bonds on the lateral external and internal surfaces of I&E fuel elements during the sizing step of the hot die size process. In a subsequent step, the end bonds are formed. Optimization studies for producing good end bonds will be reported in future interim reports.

21533 (HW–77177) **Pita IP-22, Sup I, E-N demonstration load.** Conner, E.L.; Carter, R.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Apr 1963. 7p. Sponsored by USDOE, Washington, DC (United States).

DOE Contract AC06-76RL01830. Order Number DE94011076. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this report is to permit the charging of the fourth E-N demonstration loading at H Reactor; modifications in the charge makeup and the loading pattern, designed to improve the conversion ratio and to advantageously re-shape the longitudinal flux pattern, are recommended. These gains are available through utilization of the small surplus of excess reactivity, over operating requirements, in the present (third) core.

21534 (HW–77367) **Proposed irradiation of substandard fuel elements: Phase 2.** Blanton, W.A.; Weakley, E.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Apr 1963. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011287. Source: OSTI; NTIS; GPO Dep.

Declassified.

The reference letter outlined an initial proposal for irradiating limited categories of substandard fuel elements in the upstream positions of the reactor process tubes. As Phase 2 of this program, a comprehensive study has been made of all current fuel reject categories with respect to use in the upstream low rupture potential positions. This report describes additional "reject" fuel categories, the estimated cost savings, rupture potential, and procedures for identifying and handling pieces to fulfill the combined requirements of Phase 1 and 2 of this program. Future methods for grading fuel elements to reduce rupture potential in the downstream reactor positions are also outlined in this report.

21535 (HW–77523-RD) **B high tank adequacy.** Zimmerman, P.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Mar 1963. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011289. Source: OSTI; NTIS; GPO Dep.

Declassified.

The pile power level curve, which includes data from PT 528 High Tank Drawdown Test and heat decay test, represents allowable power level for a given average High Tank temperature.

21536 (HW–77528) **Crud deposition in KER loops at pH 10 LIOH.** Dickinson, D.R.; Demmitt, T.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 May 1963. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011290. Source: OSTI; NTIS; GPO Dep.

Declassified.

One of the problems which may be encountered in the operation of NPR, or of any similar pressurized-water reactor, is the deposition of crud in the reactor core, particularly on the surfaces of the fuel elements. This crud consists primarily of iron oxides resulting from the corrosion of the piping. It has generally been found to deposit preferentially in a radiation field such as is present in the reactor core. Such deposition is undesirable for two reasons. First, the crud will become activated, and on subsequent release may create radioactivity levels in the ex-reactor components of the primary loop high enough to be a hazard to maintenance and operating personnel. Secondly, the crud deposit is a poor conductor of heat, and even a rather thin film can raise the cladding temperature by 100 – 200°C and result in accelerated corrosion of the cladding.

21537 (HW–77578) **Use of depleted uranium for higher Isotope Pu.** Lang, L.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 May 1963. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011262. Source: OSTI; NTIS; GPO Dep.

Declassified.

It was stated by HAPO representatives at meetings held in Washington and Savannah River on May 1st and 2nd, that roughly 200 kgs of Pu of 18 percent Pu-240 could be furnished by July 1, 1965 to Savannah River for their proposed Cm-244 program. The Pu would be produced by irradiating .2 percent U-235 depleted uranium for a period of roughly ten months. The reactivity required for the depleted uranium irradiation would be furnished by .947 percent U-235 enriched uranium. Nine tons of slightly enriched uranium would be required for each ton of depleted uranium during its complete irradiation. To implement this program to deliver Pu of high isotope content by July 1, 1965 will require immediate internal program approvals and appropriate implementation steps. These steps will include design and specification of the depleted uranium ordering appropriate quantities of E and depleted; determining and ordering appropriate canning components; and determining reactor loading patterns. Special attention will ultimately be required in the separation of the reactor products. The additional quantities of E-metal required for the loading will probably necessitate early installation of the annular type Purex dissolver.

21538 (HW–77773) **Forecast reactor water leaks.** Young, J.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Jun 1963. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012420. Source: OSTI; NTIS; GPO Dep.

Declassified.

Reactor water leaks cause outage time for locating and eliminating the leaks and for repairing damage paused by the vater that enters the reactor. The justification for equipment and process changes necessary for reducing the number of leaks and the resultant outage time is dependent on the number of leaks expected. This document presents an estimate of the future reactor water leak frequency and the average outage time charged to each leak. A water leak is defined as any entry of vater into the reactor moderator during operation. Future vater leaks are expected to result primarily from Van Stone flange failures and miscellaneous causes such as mechanical damage, fuel ruptures, and transverse cracks. It is assumed that continuous emphasis will be placed on corrosion monitoring to determine the tubes that must be replaced to prevent leaks because of internal and external corrosion. The number of water leaks is expected to average between 80 and 100 per year in the future. The normal-range of the number of leaks probably will be between 60 and 120 per year as a result of normal variation in the process tube physical condition. The number of outage hours charged per leak is expected to continue at the past average rate of approximately twelve hours per leak.

21539 (HW–77803) **Design bases, Bauxite-sulfuric acid feed facilities 100-K area.** Etheridge, E.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Jun 1963. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010940. Source: OSTI; NTIS; GPO Dep.

Declassified.

Criteria provided in this report delineate the objective, bases, and functional requirements that shall govern the preparation of detail design of the bauxite-sulfuric acid feed facilities to be installed in the 183-KE and KW Buildings. These facilities will produce the chemical coagulant used in the treatment of Columbia River water in the water plants and thus replace the existing liquid alum feed systems used for this purpose. The objective of this document is to define the operational and technical requirements of the new process and to outline the functional requirements of the proposed facilities for the purpose of detail design. The criteria below define the requirements for a single K Area water plant. Unless otherwise stated they shall apply for both K Area water plants.

21540 (HW–78488-RD) **Report to the working committee of the fuel element development committee from the General Electric Company, Hanford.** Minor, J.E.; Riches, J.W.; Stringer, J.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Sep 1963. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010864. Source: OSTI; NTIS; GPO Dep.

Declassified.

The report is divided into: Present reactor fuel production, N-RD production fuels, N-fuel development, and current reactor fuel development.

21541 (HW–78514) **Determining initial composition of regenerating in-core neutron flux detectors.** Bunch, W.L. General

Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Sep 1963. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012024. Source: OSTI; NTIS; GPO Dep.

Declassified.

A computer program was written to calculate the initial ratio of isotopes which should be used in an in-core neutron flux detector to obtain the maximum use lifetime where the useful lifetime is defined as that period of time during which the sensitivity of the detector remains within specified limits. Input data for the program include cross sections of the isotopes to be used. In order that various reactor environments might be considered, Westcott cross sections have been employed. Westcott cross sections assume that the neutron spectrum in a thermal reactor can be characterized by the temperature, T, and by a spectral parameter, r. An experimental technique was developed for measuring these parameters. The evaluation of the parameter, r, is based on a standard technique comparing the relative radioactivity induced in bare and cadmium-covered cobalt samples. The determination of the neutron temperature, T, was made using a mass spectrometer to determine the isotopic changes in uranium and plutonium samples as a function of.exposure in the neutron flux. This is a new technique which appears to be both simple and accurate. The irradiations were made in a water-cooled irradiation facility located in the KE Hanford production reactor. Based on the results of the experimental data obtained, twelve regenerating detector elements were encapsulated and are currently undergoing irradiation in the facility to determine how precisely the calculated behavior pattern can be achieved.

21542 (HW–78547) **Comparison of physics parameters for N and K Reactors.** Nichols, P.F.; Nilson, R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Aug 1963. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011984. Source: OSTI; NTIS; GPO Dep.

Declassified.

Power, conversion ratios, Westcott flux, neutron temperature, and R values are given for the production reactors. Tables of reaction rates are also included. (GHH)

21543 (HW–78746-RD) **Interim pumping modification review.** Hedges, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Aug 1963. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012104. Source: OSTI; NTIS; GPO Dep.

Declassified.

Pumping specifications are given for the B, C, D, and DR reactors at Hanford in August 1963. The maximum capacity is given for equipment in use and equipment that could be used.

21544 (HW–78770) **Design criteria: Bauxite-sulfuric acid feed facilities 100-K Area.** Etheridge, E.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Sep 1963. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010527. Source: OSTI; NTIS; GPO Dep.

Delcassified.

These criteria delineate objective, bases, and functional requirements governing preparation of design of the bauxite-sulfuric acid feed facilities installed in the 183-KE and KW Buildings. These facilities produces the chemical coagulant used in the treatment of Columbia River water in the K Area water plants and thus replaces the existing liquid alum feed systems used for this purpose.

21545 (HW–78869) **End closure of hot die size diffusion bonded fuel elements.** Strand, C.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jan 1964. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010855. Source: OSTI; NTIS; GPO Dep.

Declassified.

Studies initiated at Hanford in 1961 for the purpose of developing an alternate cladding process for I&D fuel elements for the eight existing production reactors indicated that the hot die sizing diffusion bonding process offered the greatest incentive. Hot die sizing was the most attractive with respect to improved fuel quality and potential reduction in fuel element unit cost when compared to the existing AlSi brazing process. Initial development work consisted of determining optimum process parameters for producing good diffusion bonds on the inner and outer lateral surfaces during sizing. This report summarizes the results of a series of end bonding variables tests designed for producing good diffusion bonds on the ends of hot die sized fuel elements.

21546 (HW–78901) **Provisional specifications for prototypical lithium-aluminum target element 05T.** Wick, J.J. Jr. (General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation). General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Sep 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010536. Source: OSTI; NTIS; GPO Dep.

Declassified.

The 04T lithium-aluminum target elements that were irradiated at Hanford during the early part of 1963 indicated that a longer element would be more desirable from the standpoint of tritium production. The Production Fuels Sections was requested in late August, 1963, to manufacture a test load of "O" size elements that would be five inches in length. This document presents the manufacturing information that is necessary to make a finished target element five inches in length that will approximate the "O" size geomery with the existing supply of AlSi type aluminum components.

21547 (HW–78959) **Analysis of irradiated thorium oxide: Series I, Development Test IP-588-D.** Matsumato, W.Y.; Weiler, M.R.; Schneider, R.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Sep 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010482. Source: OSTI; NTIS; GPO Dep.

Declassified.

An analytical chemistry program was conducted to determine total U-233 and U-232/U-233 ratio in the irradiated thorium oxide. This report summaries the results for samples exposed for one month and briefly describes the analytical procedures.

21548 (HW–78986) **Interim report 1, Production Test IP-442-A half-plant reduction in process water pH, 105-D.** Geier, R.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Sep 1963. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010494. Source: OSTI; NTIS; GPO Dep.

Declassified.

A half-plant low pH test began at D Reactor on March 19, 1963. The purpose of the test was to provide quantitative data on the reduction in aluminium corrosion obtained by lowering reactor coolant pH from 7.0 to 6.6. The benefits of lower pH will be monitored by ex-reactor tube examinations) in-reactor wall thickness measurements, coupons, and visual examination pleas weight loss measurements of fuel elements. This report presents the results of the visual examination and weight loss measurements on 18 columns of fuel elements irradiated during the test.

21549 (HW–79056) **Final report on the evaluation of Harvey aluminum components under PITA-IP-12-I.** Hubert, R.V. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Sep 1963. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010493. Source: OSTI; NTIS; GPO Dep.

Declassified.

Several evaluations of Harvey "O" size natural I&E aluminum components have been made. The performance of components received prior to May 1961, was unsatisfactory. To improve component quality, Harvey made major process modifications. Components processed at HAPO after July 1, 1961, were received subsequent to Harvey's modifications, and met specifications. Procurement and evaluation of an additional 150,000 Harvey OIIIN components was authorized. Evaluation of the 5 first 150,000 Harvey OIIIN improved components suggested partial qualification.

This document reports and makes recommendations based on the test data for Harvey improved components as of August 31, 1963.

21550 (HW–79120) **Internal graphite moderator forces study, C and K Reactors.** Cooley, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Oct 1963. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011998. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this study was to determine the maximum forces that can be imposed by the graphite moderator on prospective VSR channel sleeves. In order to do this, both the origins and modes of transmission of the forces were determined. Forces in the moderator stack that are capable of acting on a block or group of blocks may originate from any of the following primary effects: Contraction of graphite due to irradiation; thermal expansion of graphite; frictional resistance to motion; resistance from keys; gravity; and other.

21551 (HW–79183) **Reactor physics monthly technical progress report, September 1963.** Nichols, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Oct 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010921. Source: OSTI; NTIS; GPO Dep.

Declassified.

The activities included the single tube fuel element study, production losses encountered upon simultaneous irradiation of Np^{237} target material, startup measurements of lattice parameters and spectral indices, neutron lifetime in N-Reactor, production estimates for tritium only, FLEX code, etc.

21552 (HW–79593) **Preliminary survey, Reactor formation of rhenium-tungsten alloy.** Lang, L.W.; Meichle, R.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Nov 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011080. Source: OSTI; NTIS; GPO Dep.

This document considers the costs of rhenium formation as produced by irradiating tungsten. Two isotopic compositions of tungsten are considered for the study. The cost for reactor-formed rhenium appears to be prohibitively high – over $20 per gram. This cost would exist for tungsten containing 90% 186, 9, 184, and 1% tungsten 182 and 183. The cost of alloy made fro natural isotopic compositions of tungsten would be higher by a factor of 3, and would take prohibitively long to produce significant quantities of rhenium. Thus, detailed numbers are not shown or considered for the natural isotopic composition of tungsten.

21553 (HW–79602-RD) **Production of tungsten-rhenium alloys in N-reactor.** Riches, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Nov 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011563. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report contains the feasibility and cost data for the production of tungsten-rhenium alloys from tungsten targets in the N-Reactor. The two types of target elements assumed were: (a) tungsten containing 90 a/o tungsten-186, 9 a/o tungsten-184 and 1 a/o tungsten-183 and 182, and (b) tungsten of natural isotopic composition.

21554 (HW–79678) **Potential problems in U-233 production.** Kofoed, R.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Nov 1963. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010540. Source: OSTI; NTIS; GPO Dep.

Declassified.

Interaction of α particles with elements of low atomic number leads to the emission of neutrons by the (α, n) reaction. The light element content may become one of the limiting factors in the production of U-233 acceptable for projected uses. Neutron production by the (α, n) reaction was calculated as functions of U-232 and light element contents.

21555 (HW–79980) **Monthly technical report, November 1963.** Nichols, P.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 2 Dec 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010497. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report details activities of the N-Reactor Reactor Physics Department during the month of November 1963.

21556 (HW–80015) **Physics study of Po^{210} production capabilities in N Reactor.** Dieterich, R.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Nov 1963. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012015. Source: OSTI; NTIS; GPO Dep.

Declassified.

The production of Po^{210} by irradiating Bi^{209} has been proposed as a possible use of N Reactor. The purpose of this study was to make an estimate of the production rates for various exposure times and flux levels. The production rate was calculated for the three flux levels of: (1) 5.0×10^{13} neutrons/cm^2/second, which is about the average flux level expected in the N Reactor graphite moderator; (2) 6.74×10^{13} neutrons/cm^2/second, which is the estimated flux level in the 68 empty process tubes on the top and bottom of the N Reactor core; (3) 7.5×10^{13} neutrons/cm^2/second, which is the estimated flux level present in a flux trap made by removing a column of fuel. In addition to the above calculations, an estimate was made of the fuel enrichment needed to support a column of bismuth in the core of the reactor; and the percentage loss in the Pu production was calculated for the reactor.

21557 (HW–80160) **Status of canning cycle optimization study.** Hutton, T.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Dec 1963. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010592. Source: OSTI; NTIS; GPO Dep.

Declassified.

A concentrated study of the present manufacturing process was initiated in the Process Engineering Unit, the purpose of the study being to optimize the present operations, procedures, and methods of the AlSi canning process. It is the purpose of this document to report the findings and accomplishments for that portion of the study concerned with the optimization of component preparation and fabrication within the canning furnace. To date, this study has consisted mainly of heating rate studies of the various components used in the fuel element fabrication with some work being done on the optimization of the heating cycle for these components. This work necessarily serves as the basis for further optimization study.

21558 (HW–80177) **Development test IP-646-D, irradiation service request HAPO 278, outgassing rate of tritium at high temperatures and hydriding corrosion of Zircaloy-2.** DeMers, A.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Dec 1964. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012536. Source: OSTI; NTIS; GPO Dep.

Declassified.

Objective of the KE reactor test is to determine the hydriding corrosion rate of Zircaloy-2 at high temperature in a damp helium atmosphere, and to determine the outgassing rate of tritium generated in a lithium-aluminum alloy. The irradiation capsule design, operating conditions, etc. are discussed.

21559 (HW–80828-Suppl.A) **PT-IP-659-AC, Supplement A transition to normal discharge plan using striped target columns.** Masche, G.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Apr 1964. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010984. Source: OSTI; NTIS; GPO Dep.

Declassified.

The scheduled termination of PT IP-659-AC, presently being irradiated in F Reactor, will result in discharge of 105 columns of enriched uranium (0.947 w/o U-235) at less than 50 per cent of the goal exposure. The test block is currently scheduled to be replaced with natural uranium columns. Since F Reactor is on a semiblock discharge plan (alternate rows), subsequent operating plans would require that 64 of these replacement columns of natural uranium be likewise discharged during the scheduled outage in May of 1964 at less than 50 per cent of goal. It appears desirable to minimize the economic costs of the production test by an alternative discharge scheme (e.g., interim poison irradiation). The objective of this supplement is to soften the economic impact of low exposure fuel discharge scheduled by IP-659-AC and simultaneously to obtain a useful alternate product by irradiating nine columns of Li-Al and Bismuth in a "striped" charge.

21560 (HW–80862) **Internal graphite moderator forces study supplemental information.** Cooley, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Feb 1964. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011986. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report discusses comments received on the previous report on internal graphite moderator forces (HW-79120); sleeve test channel inspection; and BDF reactor distortion.

21561 (HW–81379) **Production test IP-669-AC depleted uranium irradiation smaller reactors.** Gross, P.D.; Hladek, K.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Jun 1964. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012090. Source: OSTI; NTIS; GPO Dep.

Declassified.

Objective of this test is to authorize irradiation of depleted uranium in a smaller Hanford reactor.

21562 (HW–81458-RD) **Overbore fuel failure summary.** Hladek, K.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Mar 1964. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012439. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS/ fuel elements; FUEL ELEMENTS/failures; FAILURES; FUEL CANS; FAILURE MODE ANALYSIS; RUPTURES; CORROSION

21563 (HW–81515) **KER-2 operating report test K-2-17, PT IP-484-D.** Christensen, G.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Mar 1964. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010953. Source: OSTI; NTIS; GPO Dep.

Declassified.

Purpose of this test was to evaluate the behavior of LiAl elements at N-Reactor operating conditions. The test was made to determine the swelling rate of the LiAl alloy, effect of irradiation on mass transport of lithium and tritium in the target assembly, and effect of Al surface treatment on transport of lithium and tritium.

21564 (HW–81548-RD) **Co-product development for N-Reactor pp 58 through 64, HW-80908.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Mar 1964. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012441. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report provides a discussion of the co-product production of weapons grade plutonium and tritium in the N-Reactor.

21565 (HW–81569) **C Reactor overbore test facility review.** Carlson, P.A.; Nilson, R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Apr 1964. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010910. Source: OSTI; NTIS; GPO Dep.

Declassified.

In 1961, large-size, smooth-bore, Zircaloy process tubes were installed in C-Reactor graphite channels that had been enlarged to 2.275 inches. These tubes were installed to provide a test and demonstration facility for the concept of overboring as a means of securing significant improvement in the production capability of the reactors, After two years of facility operation, it is now appropriate to consider the extent to which original objectives have been achieved, to re-examine the original objectives, and to consider the best future use of this unique facility. This report presents the general results of such a review and re-examination in more detail.

21566 (HW–81615) **Report to the Working Committee of the Fuel Element Development Committee from the General Electric Company, Hanford.** Lewis, M.; Minor, J.E.; Stringer, J.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Apr 1964. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012531. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report is divided into: current reactor production fuels, N-RD production fuels, and reactor fuel development (N-Reactor, current reactor).

21567 (HW–81660) **An evaluation of the experimental determination of the effects of burnout and corrosion on spline worth.** Blyckert, W.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Jul 1964. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012421. Source: OSTI; NTIS; GPO Dep.

Declassified.

Efforts have been made to experimentally evaluate and to calculate the effect of reactor environment on splines. This report follows some of these efforts and relates them to operational experience. The use of splines in the Hanford Reactors has improved the efficiency and ease of operating the reactors. With the widespread use of splines, it is important to know the effect of reactor exposure to safely and efficiently use the splines in reactor operation.

21568 (HW–82336) **KER-4 operating report test K-4-15, PT IP-477-A, Supplement B.** Oberg, K.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Feb 1964. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010655. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this test was to further evaluate the behavior of N Reactor fuel elements at conditions equivalent to or more severe than those expected at N Reactor. A. Date Charged: June 2, 1963: B. Fuel Elements: A total of fourteen 23.2 inch NAEI elements with an enrichment of 0.947 per cent were charged. C. Exposure: The fuel elements were charged a total of 5,661 hours. Of this period, the reactor operated 3,841 hours and the loop was at desired operating conditions 3, 292 hours or 86 per cent of reactor operating time. D. Date Discharged: January 24, 1964. E. Reason for Discharge: Goal exposure reached.

21569 (HW–82665) **Technical bases: U-233 production study, Group V.** Woods, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Jun 1964. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010489. Source: OSTI; NTIS; GPO Dep.

Declassified.

Group V is the designation assigned locally to the fifth of a series of recent U-233 production studies requested by the Division of Production. The scope of this study is given in a teletype from F. P. Baranowski to J. E. Travis, which was sent on May 28, 1964 and reported to General Electric on June 1, 1964. The text is as follows: DRD has just advised that clean U-233 for seed and blanket program is wanted at early dates, as follows: 160 kg by April–July 1965; and 40 kg by July–September 1965. Both batches would be requested at 3 to 5 ppM of U-232. The DRD Branch requesting

this material insists the dates are important. However, approval for production program will be via staff paper route, and authorization to proceed may not be available until late June. Considering these circumstances, please advise: (a) portions of above quantities your site could deliver as nitrate by above dates; (b) schedules on which you could deliver half of the quantities; (c) schedules on which you could deliver the full quantities; (d) pre-authorization steps recommended to expedite program. Please provide schedules that could be reasonably guaranteed, since they could become commitments. Consider possible difficulties in obtaining suitable thorium oxide from off-site, relatively limited experience to date in making clean U-233, separations problems if short cooling is used, separation plant campaigning problems, and shortage of capital funds. The immediate purpose of this memorandum is to record the technical assumptions used in the study in order to provide a basis for cost evaluations. The general results have been reported by letter from A. B. Greninger to J. E. Travis, June 5, 1964.

21570 (HW–82972) **Technical bases, U-233 production study Group IV-A.** Woods, W.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Jun 1964. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010979. Source: OSTI; NTIS; GPO Dep.

Declassified.

Short communication. HANFORD PRODUCTION REACTORS; URANIUM 233/production; THORIUM OXIDES/irradiation; PRODUCTION; RESEARCH PROGRAMS; REACTOR FUELING; IRRADIATION

21571 (HW–83418) **Effects of several EQ fuel loadings on aluminum process tube life.** Hough, C.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Jul 1964. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010646. Source: OSTI; NTIS; GPO Dep.

Declassified.

Tube life estimates for the base case and the five study cases are given for 6.6 and 7.0 pH. The fuel sizes and operating conditions for each case are summarized. Information on the mixer position that gives maximum tube life for each case is shown. A tube life distribution was calculated for the base case using the outlet temperature distribution for 1197 central zone tubes at B reactor. Average tube life for the 1197 tubes war estimated to be 3.0 years (100 percent TOE) for operation at 6.6 pH, and the outlet temperature corresponding to average tube life vas l07°C. Similar numbers could be calculated for the study cases if estimates of the outlet temperature distributions were available.

21572 (HW–83519) **KER-2 operating report: Test K-2-22.** Christensen, G.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Aug 1964. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010585. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of this test was to evaluate the behavior of natural lithium-bearing materials and to provide samples for production and extraction information. Testing of the target elements was done in conjunction with a test evaluating the behavior of NIEl fuel elements. Conditions for operation during the test were similar to, or more severe, than conditions expected in N Reactor.

21573 (HW–83569) **Reactor phase-out discharge planning.** Dunn, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Aug 1964. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010586. Source: OSTI; NTIS; GPO Dep.

Declassified.

Reactor phase-out discharge planning involves forcing all tubes into a discharge pattern such that they can all be discharged at the appointed time with maximum fuel utilization. When considering reactors operating on the block discharge concept, action must be taken early to cause the fringe to reach goal exposure at the same times as the central core. For the case of alternate row or random discharge of core material, there is the additional problem of discharging all core tubes at a single outage without greatly underexposing or overexposing either of the discrete batches involved.

21574 (HW–83687) **Fuel element development committee: Annual report from the General Electric Company, Hanford.** Lewis, M.; Minor, J.E.; Stringer, J.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Aug 1964. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012028. Source: OSTI; NTIS; GPO Dep.

Declassified.

A summary of HAPO activities is given to include separate sections on the N-Reactor and other current production reactors. Specific programs and fuel performance for current production reactor fuels is discussed. Also, the production status, fuel performance, development program and process technology for N-Reactor fuels is presented.

21575 (HW–83861-RD) **Irradiation analysis, PT-IP-714: Irradiation of solid aluminum in KER-1, KER-2, KER-3, and KER-4 with process water cooling.** Gerdes, K.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Aug 1964. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010915. Source: OSTI; NTIS; GPO Dep.

Declassified.

This production test authorizes the irradiation of full length charges of solid aluminum in the KER loops while on single-pass operation with process water cooling. Calculations show that the irradiations will not result in any foreseen reactor or personnel hazards and can be safely performed in the KER facilities.

21576 (HW–83870) **Hydraulic supply and demand characteristics of thorium target elements in B, C, D, and K process tubes.** Angle, C.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Sep 1964. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011322. Source: OSTI; NTIS; GPO Dep.

Declassified.

In conjunction with the proposed thorium target element replacement program, hydraulic tests were performed in the Hydraulics Laboratory in 185-D building to determine the flow characteristics of 1.480-inch OD solid thorium loadings in B, C, D, and K fringe tubes. Included are supply curve data for those orifice combinations which are tentatively to be used with the thorium loads in the various fringe tubes. In addition, predicted supply-demand characteristics are presented for a loading of 1.600-inch OD thorium solids in a K-Reactor Zircaloy-2 process tube equipped with a 0.270-inch flat-plate orifice in a X central zone double-orifice retainer union (cage), Drawing H-1-21952.

21577 (INIS-JP–018, pp. 1572-1579) **One piece reactor removal: An innovative approach for research reactor renewal.** Chia, Wei-Min (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan (China)); Wang, Song-Feng. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The strategy of Taiwan Research Reactor Renewal plan is to remove the old reactor block with One Piece Reactor Removal (OPRR) method for installing a new research reactor in original building. In this paper, the engineering design of each transportation works including the work method, the major equipments, the design policy and design criteria is described and discussed. In addition, to ensure the reactor block is safety transported for storage and to guarantee the integrity of reactor base mat is maintained for new reactor, operation safety is drawn special attention, particularly under seismic condition, to warrant safe operation of OPRR. ALARA principle and Below Regulatory Concern (BRC) practice were also incorporated in the planning to minimize the collective

dose and the total amount of radioactive wastes. All these activities are introduced in this paper. (J.P.N.).

21578 (JAERI-M–93-228, pp. 1017-1024) **Current status and future of utilization in research reactors.** Koyama, Yoshimi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hoshi, Yoshio; Nemoto, Denjiro; Takahashi, Hidetake. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

In research reactors of Japan Atomic Energy Research Institute (JAERI), JRR-3 was upgraded (so called JRR-3M) with irradiation facilities and neutron beam experimental facilities. Particularly the new supply of cold neutrons brings to a great increase of fields of utilization in research reactors of JAERI. In JRR-4, it is planned to reduce the fuel enrichment and to renew several utilization facilities in several years. JRR-2 will be shut down also in several years because of its superannuation. On the other hand most research reactors of other institutes in Japan have faced with their superannuation and the difficulties of refurbishment or upgrading as well as new construction because of the changes of environmental condition such as urbanization of their surroundings. The research reactors in JAERI will play more important role for research and development using neutrons in future than past and present. Therefore the investigation was made in order to catch the needs for utilization of research reactors. The results of this investigation show that there are many research institutes which hope to utilize research reactors in accordance with the increase of available fields such as research of high polymer, biology, industrial materials and components, and contribution to environmental investigation by using neutron scattering, neutron radiography and activation analysis. This means that the research reactor utilization will be able to contribute to general scientific fields as well as utilization for research and development of nuclear energy which have been popular as utilization of research reactors. In this presentation, the current status of utilization of research reactors in JAERI and utilization fields of research reactors expected in future based on the investigation are described. It is also discussed what is important for the utilization to use effectively the research reactors in JAERI. (author).

21579 (JAERI-M–94-004) **Basic experiments of reactor physics using the critical assembly TCA.** Obara, Toru (Tokyo Inst. of Tech. (Japan). Research Lab. for Nuclear Reactors); Igashira, Masayuki; Sekimoto, Hiroshi; Nakajima, Ken; Suzaki, Takenori. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 45p. (In Japanese). Order Number DE94770632. Source: OSTI; NTIS; INIS.

This report is based on lectures given to graduate students of Tokyo Institute of Technology. It covers educational experiments conducted with the Tank-Type Critical Assembly (TCA) at Japan Atomic Energy Research Institute in July, 1993. During this period, the following basic experiments on reactor physics were performed: (1) Critical approach experiment, (2) Measurement of neutron flux distribution, (3) Measurement of power distribution, (4) Measurement of fuel rod worth distribution, (5) Measurement of safety sheet worth by the rod drop method. The principle of experiments, experimental procedure, and analysis of results are described in this report. (author).

21580 (JAERI-M–94-005) **Development of code system for management of reactor decommissioning (COSMARD), 1: Description of project management data calculation facility and it's user guide.** Yanagihara, Satoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ogihara, Hirohito. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 71p. (In Japanese). Order Number DE94770642. Source: OSTI; NTIS; INIS.

The Code System for Management of Reactor Decommissioning (COSMARD) was developed for use in the effective planning and management of reactor decommissioning. The decommissioning management data evaluation facility (DMAF) which is the main part of COSMARD has functions to evaluate various project management data such as manpower needs, radiation exposure of workers, amount of waste arisings necessary for each activity in a project using input data and calculation models consisting of simple arithmetic formulas and unit factors in the database. Using a set of command descriptors developed in COSMARD, work conditions and procedures for decommissioning a nuclear facility are describes as input data. The management data are evaluated by adopting the calculation models, which are placed in the activities at the lowest level of the work breakdown structure (WBS). The management data evaluated by the models are summed up in the ascending direction of WBS to obtain necessary data for the activities at any levels of WBS. In addition, scheduling calculations are conducted to obtain scheduling bar chart and histograms of the management data, on the basis of the work precedence conditions attached at certain activities. This report describes the outline of DMAF and user's manual of the sets of command descriptors. (author).

21581 (JAERI-M–94-006) **Thermal-hydraulic conceptual design of the multiple purpose research reactor.** Lucatero, M.A. (Instituto Nacional de Investigaciones Nucleares Mexico City (Mexico)); Kaminaga, Masanori. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 46p. Order Number DE94770605. Source: OSTI; NTIS; INIS.

The Multiple Purpose Research Reactor MEX-15 is a 15 MW thermal power, swimming pool type research reactor and will be constructed by the National Institute of Nuclear Research (ININ) of Mexico. Demineralized light water will be used as coolant and moderator. The reactor core will be surrounding by graphite reflectors. The reactor will use 19.75% enriched U_3O_8-A1 plate-type fuel (MTR-type). The core thermal-hydraulic conceptual design of the MEX-15 was performed for two cooling modes, forced convection cooling and natural convection cooling. The key criteria are first to avoid the nucleate boiling anywhere in the core and second to have enough safety margin to the DNB for normal operation conditions. The results of the thermalhydraulic conceptual design and analysis show that the optimum coolant velocity in the standard fuel element is about 5.6 m/s with the minimum temperature margin against the ONB temperature of about 17degC and the minimum DNBR of 2.58 for the forced-convection cooling mode at a core power of 15 MW with the pressures of 1.43 kg/cm^2 at the core inlet and a core inlet coolant temperature of 35degC. It was also determined that the total core power up to about 300 kW can be removed by the natural convection cooling under the condition that nucleate boiling is not allowed anywhere in the core. The minimum temperature margin against ONB temperature and the minimum DNBR at 300 kW are 1.6degC and 6.31, respectively. The results obtained in this work establishes the preliminary technical specifications for the core thermal-hydraulic design of the Multiple Purpose Research Reactor MEX-15. (author).

21582 (JAERI-M–94-013) **Study of air vent design for inverted U-tube type heat exchanger.** Takada, Shoji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shibata, Mitsuhiko; Kato, Mitio; Fujisaki, Katsuo; Ohta, Yukimaru; Kobayashi, Toshiaki; Hayashi, Haruyoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 95p. (In Japanese). Order Number DE94770594. Source: OSTI; NTIS; INIS.

A two-phase flow has characteristics of the blockage instability in which voids prevent and stop the water flow in an inverted U-tube. In cooler c_{32} employing inverted U-tubes, changes of heat transfer performance, abnormal mechanical vibrations and corrosions on the surfaces of cooling tubes had been observed during the operations of HENDEL (Helium Engineering Demonstration Loop). It was assumed that the causes of these abnormal events were air stagnated in inverted U-tubes when cooling water was filled before HENDEL operation. A blockage instability of two-phase flow and stability boundaries were investigated with an experimental apparatus composed of water plenums and an inverted U-tube which is parallel to a bypass channel. 'Dynamic air vent' and 'Vacuum air vent' methods were additionally suggested to reject the stagnated air in the inverted U-tubes. As the results of experiments, the possibility of Dynamic air vent method was verified using the experimental apparatus. And, the usefulness of Vacuum air vent

method was also demonstrated through the tests employing cooler C_{32} of HENDEL. (author).

21583 (JAERI-M–94-020) **Tubular radiation source measurement for verification of the FP plate-out activities in the OGL-1 primary cooling system.** Matsumoto, Mikio (Nuclear Engineering Co., Hitachi, Ibaraki (Japan)); Ito, Haruhiko; Baba, Osamu; Itabashi, Yukio. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 44p. (In Japanese). Order Number DE94770636. Source: OSTI; NTIS; INIS.

Activities and distribution of fission products (FPs), which plated-out in the primary cooling system of the High Temperature Engineering Test Reactor (HTTR), are important for the design, maintenance and accident analysis of the reactor. In the department of JMTR project, the distribution of FPs plated-out on inner surface of the primary cooling system piping of the high temperature gas cooling in-pile loop facility (OGL-1) has been measured during reactor operation and after shutdown. The OGL-1 is utilized for irradiation tests of the HTTR fuels. It became clear in the measurement that a large amount of ^{137}Cs plated-out on the piping whose operation temperature was around 500degC, and ^{137}Cs plated-out on the 500degC piping was released with decrease of FPs release from fuel to primary gas and redeposited on the piping in temperature range of 200-300degC. It was also found that ^{131}I release rate from HTTR fuels in irradiation was $2x10^{-7}$-$4x10^{-5}$. In this report, tubular radiation source measurement for verification of the FP plated-out activities in the OGL-1 primary cooling system was shown. Measurement error of plated-out activities in the OGL-1 primary cooling system was evaluated to be within 20%. (author).

21584 (JAERI-M–94-029) **Characteristics of polyethylene and zirconium-hydride moderator for the NSRR tests.** Nakamura, Takehiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Yamazaki, Toshi; Sobajima, Makoto. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 105p. (In Japanese). Order Number DE94770637. Source: OSTI; NTIS; INIS.

Pulse irradiation tests of FBR fuels under the sodium cooling conditions are planned for the phase III program in the NSRR (Nuclear Safety Research Reactor), following the phase I and II programs of the LWR fuel tests under the simulated RIA (Reactivity Initiated Accident) conditions. A proto-type irradiation capsule for the FBR fuel rod tests and a sodium loop to purify and to charge sodium into the capsule are under construction for the tests. In the NSRR tests, neutron moderator is needed to thermalize neutrons from the driver core and to subject transient energy high enough to cause the test fuel failure. The light water has been used for the NSRR LWR fuel tests as the coolant/moderator material. Polyethylene and zirconium-hydride are candidates of the moderator for the FBR fuel tests. The capability of the moderators are investigated in the pulse irradiation tests in the NSRR. Both of the moderators indicated good capability of realizing high thermal neutron flux to subject energy depositions comparable to the light water or higher. Estimations by the SRAC code system indicated reasonable good agreement with the test results. In addition, heating tests of the moderators did not cause gas decomposition nor dissociation, indicating that the moderators are operative at temperatures up to 300degC. (author).

21585 (JAERI-M–94-042) **Proceedings of the 16th international meeting on reduced enrichment for research and test reactors.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 466p. (CONF-9310321–: 16. international meeting on reduced enrichment for research and test reactors, Oarai (Japan), 4-7 Oct 1993). Order Number DE94770645. Source: OSTI; NTIS; INIS.

This issue is the collection of the papers presented at the title conference. The 41 of the presented papers are indexed individually. (J.P.N.).

21586 (JAERI-M–94-052) **COOLOD-N2: a computer code, for the analyses of steady-state thermal-hydraulics in research reactors.** Kaminaga, Masanori (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 50p. Order Number DE94770633. Source: OSTI; NTIS; INIS.

The COOLOD-N2 code provides a capability for the analyses of the steady-state thermal-hydraulics of research reactors. This code is revised version of the COOLOD-N code, and is applicable not only for research reactors in which plate-type fuel is adopted, but also for research reactors in which rod-type fuel is adopted. In the code, subroutines to calculate temperature distribution in rod-type fuel have been newly added to the COOLOD-N code. The COOLOD-N2 code can calculate fuel temperatures under both forced convection cooling mode and natural convection cooling mode as well as COOLOD-N code. In the COOLOD-N2 code, a 'Heat Transfer package' is used for calculating heat transfer coefficient, DNB heat flux etc. The 'Heat Transfer package' is subroutine program and is especially developed for research reactors in which plate-type fuel is adopted. In case of rod-type fuel, DNB heat flux is calculated by both the 'Heat Transfer package' and Lund DNB heat flux correlation which is popular for TRIGA reactor. The COOLOD-N2 code also has a capability of calculating ONB temperature, the heat flux at onset of flow instability as well as DNB heat flux. (author).

21587 (JINR-E–3-93-430) **Multi-beam neutron reflectometer for a steady state reactor.** Aksenov, V.L. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics); Korneev, D.A.; Chernenko, L.P.; Maayof, R.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 18p. Order Number DE94626399. Source: OSTI; NTIS (US Sales Only); INIS.

A design has been proposed for a neutron reflectometer to test glass surface by neutron controls and to study surfaces and thin films at the ET-R R-1 steady state reactor of the Atomic Energy Authority of Egypt. (author.). 14 refs.; 6 figs.; 2 tabs.

21588 (SR/H–739) **The metal fabrication program for the Clinton Engineer Works and the Hanford Engineer Works: including the Dummy Slug Program and the Unbonded Slug Program – Project 1553.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Engineering Dept. Aug 1945. 290p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE94013519. Source: OSTI; NTIS; GPO Dep.

The uranium slugs were used as the charge into the pile for the manufacture of minute quantities of plutonium. So little was known of uranium's commercially adaptable physical properties that it was relegated almost to the category of a laboratory curiosity. A series of experimental and developmental programs were inaugurated to determine not only the extrudability, machinability and other physical properties, but also the influence on these of microscopic quantities of impurities present in the uranium. This historical document describes these early studies in the following sections: exceptional characteristics of the slug program; extrusion; drawing, waging and rolling; outgassing and straightening; Project 1030 (procurement of an additional sixty tons of finished slugs over and above that quantity originally supplied to the Clinton Laboratories) Machining, grinding and grooving; development of canning methods; production of canned slugs; and The Dummy Slug program.

21589 (VKTA–93-11) **Study into a more neutron-effective coupling of beam holes surrounded by a water reflector to the reactor core.** Huettel, G.; Reiche, C. Verein fuer Kernverfahrenstechnik und Analytik Rossendorf e.V. (VKTA), Dresden (Germany). Sep 1993. 22p. (In German). Order Number DE94774132. Source: OSTI; NTIS (US Sales Only); INIS.

The neutronic coupling of the radial, horizontal beam holes in the RFR has been investigated experimentally (in RAKE-2) and by two calculation models. (HP)

21590 (VKTA–93-12) **Computation and characterization of the nuclear fuels irradiated in the reactors of the VKTA.** Franke, E.; Rietzschel, R. Verein fuer Kernverfahrenstechnik und Analytik Rossendorf e.V. (VKTA), Dresden (Germany). Sep 1993. 70p. (In German). Order Number DE94774133. Source: OSTI; NTIS (US Sales Only); INIS.

A large portion of the irradiated nuclear fuel stored at VKTA facilities stems from the operation of the Rossendorf-based reactors, such as the RFR, RRR, and RAKE, or from the fuel processing

activities in the AMOR facilities (Rossendorf installation for molybdenum production). As a result of the decision to shut down the three reactors and to decommission some part of the AMOR facility, a plan is to be established for the disposal of the spent fuel or the further utilization of the irradiated fuel inventary. In order to prepare the necessary plans for ultimate disposal, interim storage at the VKTA, and the related transport activities including assessment of risks during transport, the paper in hand establishes fuel characteristics covering the following information: mass distribution (concentrations) of actinides and fission products, activity levels of actinides and fission products, neutron sources and gamma sources, thermal conditions, gamma radiation levels. (orig.)

21591 (WSRC-TR–93-506) **Flow instability and critical heat flux in a ribbed annulus.** Yang, B.W. (Columbia Univ., New York, NY (United States)); Dougherty, T.; Fighetti, C.; Kokolis, S.; Reddy, G.D.; McAssey, E.V. Jr.; Coutts, A. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940809–3: 10. international heat transfer conference, Brighton (United Kingdom), 14-18 Aug 1994). Order Number DE94002529. Source: OSTI; NTIS; INIS; GPO Dep.

An experimental program has been conducted to determine the onset of flow instability point in a heated annulus which is divided into four sub channels by non-conducting ribs. The onset of flow instability is identified by the minimum point in the pressure drop-velocity curve. Comparison with a ribless annulus show that the presence of ribs increases the minimum point velocity. In addition, data are presented which show that under certain conditions premature CHF can be induced by the ribs.

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Refer also to citation(s) 21314, 21326, 21345, 21371, 21373, 21377, 21448, 21459, 21466, 21512, 22205, 22688, 23294, 23295, 23297

21592 (ANL/ET/CP–83065) **The foaming of U-Al fuel under simulated reactor accident conditions.** Neimark, L.A.; Liu, Y.Y. Argonne National Lab., IL (United States). Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9009108–3: International meeting on reduced enrichment for research and test reactors, Newport, RI (United States), 23-27 Sep 1990). Order Number DE94013320. Source: OSTI; NTIS; INIS; GPO Dep.

Postirradiation heating tests were conducted on segments of UAl_4/Al dispersion fuel plates clad with Al to scope the foaming (rapid swelling) behavior of such fuels during beyond-design-basis accident scenarios. Four tests investigated maximum temperature, ramp rate, and duration with a liquid phase as parameters in foam formation and stability. Real-time fission-gas release was also determined during the foaming process. Ramp-rate had the most noticeable effect of foam formation and collapse.

21593 (ANL/RE/CP–81162) **Mechanical testing of high-damping elastomer materials for determining design parameters of seismic isolation bearings.** Hughes, T.H.; Kulak, R.F. Argonne National Lab., IL (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940752–4: 5. U.S. national conference on earthquake engineering, Chicago, IL (United States), 10-14 Jul 1994). Order Number DE94013336. Source: OSTI; NTIS; GPO Dep.

High-damping steel-laminated elastomeric bearings are one of the devices used for isolating large buildings and structures from earthquake damage. These load-bearing isolators are constructed from alternating layers of high-damping rubber and steel plates. In this paper the mechanical testing of small specimens of some elastomer compounds proposed for the isolation of advanced nuclear reactors is discussed. Variation of shear stiffness and damping with respect to shear strain level (5 % to 300 %), temperature (−40°C to +50°C) and frequency (0.002Hz to 5Hz) are reported. Problems involved in obtaining reliable and repeatable results are also discussed.

21594 (ANL/RE/CP–82357) **Use of a viscoelastic model for the seismic response of base-isolated buildings.** Uras, R.A. Argonne National Lab., IL (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–21: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012460. Source: OSTI; NTIS; INIS; GPO Dep.

Due to recent developments in elastomer technology, seismic isolation using elastomer bearings is rapidly becoming an acceptable design tool to enhance structural seismic margins and to protect people and equipment from earthquake damage. With proper design of isolators, high-energy seismic input motions are transformed into low-frequency, low energy harmonic motions and the accelerations acting on the isolated building are significantly reduced. Several alternatives exist for the modeling of the isolators. This study is concerned with the use of a viscoelastic model to predict the seismic response of base-isolated buildings. The in-house finite element computer code has been modified to incorporate a viscoelastic spring element, and several simulations are performed. Then, the computed results have been compared with the corresponding observed data recorded at the test facility.

21595 (BNL-NUREG–49023) **Risk comparisons based on representative source terms with the NUREG-1150 results.** Mubayi, V.; Davis, R.E.; Hanson, A.L. Brookhaven National Lab., Upton, NY (United States). Dec 1993. 13p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940312–61: 2. Probabilistic safety assessment and management conference (PSAM), San Diego, CA (United States), 20-24 Mar 1994). Order Number DE94011926. Source: OSTI; NTIS; INIS; GPO Dep.

Standardized source terms, based on a specified release of fission products during potential accidents at commercial light water nuclear reactors, have been used for a long time for regulatory purposes. The siting of nuclear power plants, for example, which is governed by Part 100 of the Code of Federal Regulations Title 10, has utilized the source term recommended in TID-14844 supplemented by Regulatory Guides 1.3 and 1.4 and the Standard Review Plan. With the introduction of probabilistic risk assessment (PRA) methods, the source terms became characterized not only by the amount of fission products released, but also by the probability of the release. In the Reactor Safety Study, for example, several categories of source terms, characterized by release severity and probability, were developed for both pressurized and boiling water reactors (PWRs and BWRs). These categories were based on an understanding of the likely paths and associated phenomenology of accident progression following core damage to possible failure of the containment and release to the environment.

21596 (BNL-NUREG–49538) **High-temperature hydrogen-air-steam detonation experiments in the BNL Small-Scale Development Apparatus.** Ciccarelli, G.; Ginsberg, T.; Boccio, J.; Economos, C.; Finfrock, C.; Gerlach, L.; Sato, K. Brookhaven National Lab., Upton, NY (United States). [1993]. 16p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-931079–28: 21. water reactor safety information meeting, Bethesda, MD (United States), 25-27 Oct 1993). Order Number DE94011736. Source: OSTI; NTIS; GPO Dep.

The Small-Scale Development Apparatus (SSDA) was constructed to provide a preliminary set of experimental data to characterize the effect of temperature on the ability of hydrogen-air-steam mixtures to undergo detonations and, equally important, to support design of the larger-scale High-Temperature Combustion Facility (HTCF) by providing a test bed for solution of a number of high-temperature design and operational problems. The SSDA, the central element of which is a lo-cm inside diameter, 6.1-m long tubular test vessel designed to permit detonation experiments at temperatures up to 700K, was employed to study self-sustained detonations in gaseous mixtures of hydrogen, air, and steam at temperatures between 300K and 650K at a fixed pressure of 0.1 MPa. Detonation cell size measurements provide clear evidence that the effect of hydrogen-air gas mixture temperature, in the range 300K to 650K, is to decrease cell size and, hence, to increase the sensitivity of the mixture to undergo detonations. The

effect of steam content, at any given temperature, is to increase the cell size and, thereby, to decrease the sensitivity of stoichiometric hydrogen-air mixtures. The one-dimensional ZND model does a very good job at predicting the overall trends in the cell size data over the range of hydrogen-air-steam mixture compositions and temperature studied in the experiments. Experiments were conducted to measure the rate of hydrogen oxidation in the absence of ignition sources at temperatures of 500K and 650K, for hydrogen-air mixtures of 15 percent and 50 percent, and for a mixture of equimolar hydrogen-air and 30 percent steam at 650K. The rate of hydrogen oxidation was found to be significant at 650K. Reduction of hydrogen concentration by chemical reaction from 50 to 44 percent hydrogen, and from 15 to 11 percent hydrogen, were observed on a time frame of minutes.

21597 (BNL-NUREG–60231) **Safety significance of inadvertent operation of motor operated valves in nuclear power plants.** Ruger, C.J.; Higgins, J.C.; Carbonaro, J.F.; Hall, R.E. Brookhaven National Lab., Upton, NY (United States). [1994]. 19p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940774–1: 3. ASME/NRC symposium on valve and pump testing, Washington, DC (United States), 18-21 Jul 1994). Order Number DE94011924. Source: OSTI; NTIS; INIS; GPO Dep.

This report addresses concerns about the consequences of valve mispositioning which were brought to the forefront following an event at Davis Besse in 1985 (NRC, 1985a). The concern related to the ability to reposition "position changeable" motor operated valves (MOVs) in the event of their inadvertent operation from the control room and was documented in Nuclear Regulatory Commission (NRC) Bulletin 85-03 (NRC, 1985b) and Generic Letter (GL) 89-10 (NRC, 1989). The mispositioned MOVs may not be able to be returned to their required position due to high differential pressure (dP) or high flow conditions across the valves. The inability to reposition such valves may have significant safety consequences as in the Davis Besse event. However, full consideration of such mispositioning in safety analyses and in MOV test programs can be labor intensive and expensive. Industry raised concerns that consideration of position changeable valves under GL 89-10 would not decrease the probability of core damage to an extent which would justify licensee costs. As a response, Brookhaven National Laboratory (BNL) has conducted separate scoping studies for both Boiling Water Reactors (BWRS) and Pressurized Water Reactors (PWRs) using Probabilistic Risk Assessment (PRA) techniques to determine if such valve mispositioning by itself is significant to safety. The approach utilized internal events PRA models to survey the order of magnitude of the risk significance of valve mispositioning by considering the failure of selected position changeable MOVS. The change in core damage frequency (CDF) was determined for each valve considered and the results were presented as a risk increase ratio for each of four assumed MOV failure rates. The risk increase ratios resulting from this failure rate sensitivity study can be used as a basis for a judgement determination of the risk significance of the MOV mispositioning issue for BWRs and PWRS.

21598 (DOE/FTR–94008708) **Travel to Sweden to discuss decommissioning of the Paldiski Training Reactor Facility: Foreign trip report, January 23–28, 1994.** Nalezny, C.L. (USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Development); Hunter, T.O. Sandia National Labs., Albuquerque, NM (United States). 7 Mar 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94008708. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of the trip was to attend a meeting sponsored by the Swedish Ministry of Foreign Affairs, and the Swedish Radiation Protection Institute to discuss decommissioning of the Paldiski Training Reactor Facility. The topics covered in the meeting included planning, reviews, measurements, decontamination, dismantling, radioactive waste conditioning, transport and disposal. Participants included representatives from Sweden, Russia, Estonia, Finland, Germany, the International Atomic Energy Agency (IAEA), the Commission of the European Communities (CEC), and the United States (US).

21599 (DOE/FTR–94009629) **Travel to France to attend and to present a paper on ex-vessel boiling at the Organization for Economic Cooperation and Development: Foreign trip report, March 7–12, 1994.** Chu, Tze Yao. Sandia National Labs., Albuquerque, NM (United States). 4 Apr 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94009629. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The scope of the workshop is best described by the title of the invited overview paper, "In-Vessel Core Debris Cooling Through External Flooding of the Reactor Pressure Vessel." The topics include: molten pool (core) heat transfer; thermal and mechanical response of the reactor pressure vessel; external cooling of the reactor pressure vessel; and systems studies. The main observations are: (1) The U.S. DOE programs issue resolution oriented studies, whereas, the European programs are more general in nature. Therefore, the DOE sponsored papers provided data that are more directly applicable to evaluating the potential of in-vessel core retention. (2) The increasing number of large-scale, comprehensive investigations in progress at OECD member countries means that prominent contributions to reactor safety will be coming from these countries in the near future. (3) The paper on ex-vessel boiling experiments for in-vessel core retention performed in the Sandia Cylindrical Boiling (CYBL) facility was well received.

21600 (DPW–56-106-Del.Ver.) **Reactor safety determination Savannah River Plant.** Menegus, R.I.; Ring, H.F. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Atomic Energy Div. Feb 1956. 275p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–734). Order Number DE94012624. Source: OSTI; NTIS; GPO Dep.

Large quantities of radioactive material are present in the Reactor and Separations Areas of the Savannah River Plant. This report deals with the precautions that were taken in the design of the plant to guard against the escape of radioactive material, and with the various devices and procedures that have been provided to assure safe operation under foreseeable operating conditions. Because no amount of care and foresight can guarantee against the risk of accident, one must assume that there is a remote possibility that a serious release of radioactive material can occur even in a very carefully designed plant. Once liberated to the surroundings, radioactive material may be spread by wind and water. No effective control of these agents is possible. The obvious preventive measure is isolation of the plant site from centers of population. So far as is practicable, this has been done at Savannah River, but the need for communications, power and a work force makes it impossible to secure the full benefits that might be derived from complete isolation of the plant. In order to calculate the magnitude of the hazard to people outside the plant site, it is necessary to assume the occurrence of highly improbable events - the very events that this design seeks to prevent by careful design and operation. Nevertheless, if one assumes a release of radioactivity, one must estimate the airborne and waterborne radioactive burdens carried off the plant site, if one wishes to evaluate the hazard to which the off-site populace is exposed. The climate and the geology of the plant site determine the direction of transport and the dilution of the radioactive material. This information, together with data on the distribution of the population around the site, may be used to estimate the damage to be anticipated in the improbable event of the release of large quantities of radioactive material.

21601 (ESTSC–000711D0VAX00) **OXIDE4: Graphite-Water Oxidation Reactions in a Modular High Temperature Gas-Cooled Rear.** Peeroomian, M.B. (General Atomics, San Diego, CA (United States)); Barsell, A.W.; Saeger, J.C.; Landoni, J.H.; Tangirala, V. General Atomics, San Diego, CA (United States). 23 Sep 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape. Package compiled without error. Linkage failed undefined symbols (MERR, TICKER, WARN).

OXIDE4 is developed for the purpose of analyzing the transient effects of accidental inleakage of steam and/or air to the primary coolant system of MHTGR.

21602 (GRS–103) **Post-inertization of large dry containments in case of beyond-design base events in PWR plants: State of the art and first considerations.** Tiltmann, M.; Risse, D.; Pana, P.; Huettermann, B.; Rohde, J. Gesellschaft fuer Anlagen- und Reaktorsicherheit (GRS) mbH, Koeln (Gemany). Dec 1993. 88p. (In German). Sponsored by Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Contract BMU SR 465. Order Number DE94773679. Source: OSTI; NTIS (US Sales Only); INIS.

The objective is to present a summary of basic thoughts and concepts as described in various publications. The report points out the obvious advantages and disadvantages of individual strategies as wel as the requirements derived from the knowledge of possible accident sequences for such a concept. Scoping calculations on the injection of inert-gas into the containment during the progress of accidents revealed additional indications as regards e.g. the required amount of inert-gas, the injection rate, and the resulting pressure behaviour in the containment. Thereby an assessment of the effectiveness as well as of the feasibility of such measures has become possible. From the large number of different initial conclusions, two major ones are singled out and presented: (1) In principle, the technical realisation of post-inerting is possible. Thus a deflagration of hydrogen in the containment can be prevented; (2) Post-inerting cannot be realised independent of the accident progress. Specific criteria for carrying out such measures will require extensive examinations. (orig./HP)

21603 (HW–57419) **Casualty study of KER-1 loop dump valve.** Spampinato, J.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Sep 1958. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010831. Source: OSTI; NTIS; GPO Dep.

Declassified.

A study has been made to determine the adequacy of the KER-1 loop emergency dump valve in protecting the fuel elements against damage during a loop casualty. In a functional test of the radiation trip procedure of the KER-1 loop during a reactor outage, it was found that the indicated process water flow was much lower than expected. Subsequent inspection of the emergency dump valve showed that the dump port was considerably blocked with rust and scale, creating a flow restriction. As it was thought that inadequate cooling water flow could result if a similar situation occurred when the reactor was at normal power levels, a study was made of the loop and the adequacy of the valve to handle casualties.

21604 (HW–58813) **Full reactor-E-N-load-review of the hazards from a chemical viewpoint.** DeHollander, W.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Dec 1958. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012813. Source: OSTI; NTIS; GPO Dep.

Declassified.

chemical Research and Development Operation was contacted by R. Nilson of Irradiation Processing Department in order to obtain an analysis from a chemical viewpoint of the worst credible accident to a full E-N reactor loading. This analysis would be used to present to the ACRS directly or would be abstracted to prepare a supplementary report. The primary purpose of this report is to present an analysis of the chemical behavior of an E-N loading in the event of the sudden loss of coolant to the entire reactor, with, however, normal operation of the control devices such that the reactor is initially driven sub-critical. We are here concerned wit the effect of a rising temperature upon the E-N load, the rise in temperature being primarily caused by the release of fission product energy.

21605 (HW–59696) **K Water Plant improvements.** Trumble, R.E.; Heacock, H.W.; Reinig, L.P.; Jones, S.S.; Mollerus, F.J. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Mar 1959. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013507. Source: OSTI; NTIS; GPO Dep.

Declassified.

A Task Force was established in the Irradiation Processing Department to examine the K-Reactor Water Plant to (1) review the operating and maintenance experience with the water plant as improved since startup, (2) identify major plant additions which could further improve reliability, and (3) estimate the costs of any such additions. The K-Water Plant basically consists of the electrically driven primary cooling system with power supplied by the BPA system, electrically driven secondary or backup cooling system powered by a steam driven emergency generator pair, and a "last ditch" system consisting of hydraulic cross-ties between the two K-Water Plants. This report summarizes information developed in the course of the Task Force deliberations.

21606 (HW–63157) **Parametric analysis of Hanford speed of control criterion.** Nilson, R.; Tiller, R.E.; Peden, J.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Jul 1961. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010961. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report examines the many interrelated nuclear, physical, and mechanical phenomena and actions which take place following a loss-of-coolant accident in a Hanford reactor operating at equilibrium power.

21607 (HW–65438) **Sub-cooled burnout relative to Hanford reactors.** Carlson, P.A.; Trumble, R.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 31 May 1960. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011993. Source: OSTI; NTIS; GPO Dep.

Declassified.

In the Hanford production reactors, failure of fuel element cladding is known as subcooled burnout since the bulk coolant temperature is below the saturation temperature at time of failure or burnout of the fuel cladding. The heat generation rate at which subcooled burnout occurs, establishes a limit to allowable reactor power level. This document compares present and potential power level limits at the Hanford production reactors with power level limits established by subcooled burnout.

21608 (HW–68409) **Some fire and fission product release possibilities for discharged fuel slugs.** Zima, G.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Feb 1961. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010528. Source: OSTI; NTIS; GPO Dep.

Declassified.

An attempt was made to appraise the slug fire and fission product possibilities associated with held-up slugs, as a function of slug power and down-time before discharge. Limitations of the data are discussed and suggestions given for refinement and related hazards analyses.

21609 (HW–75779) **Minimizing consequences of an attack threat.** Pirode, C.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Dec 1962. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010614. Source: OSTI; NTIS; GPO Dep.

Declassified.

Assistance was requested in reviewing and comparing certain measures that could be effected immediately with little capital cost to render the plant less vulnerable to self-destruction in case of a war situation that made it impossible to man the water plants. Several courses of action have been considered with the assumptions detailed.

21610 (IS–5087) **Demonstrate Ames Laboratory capability in Probabilistic Risk Assessment (PRA).** Bluhm, D.; Greimann, L.; Fanous, F.; Challa, R.; Gupta, S. Ames Lab., IA (United States). Jul 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE94005570. Source: OSTI; NTIS; GPO Dep.

In response to the damage which occurred during the Three Mile Island nuclear accident, the Nuclear Regulatory Commission (NRC) has implemented a Probabilistic Risk Assessment (PRA) program to evaluate the safety of nuclear power facilities during events with

a low probability of occurrence. The PRA can be defined as a mathematical technique to identify and rank the importance of event sequences that can lead to a severe nuclear accident. Another PRA application is the evaluation of nuclear containment buildings due to earthquakes. In order to perform a seismic PRA, the two conditional probabilities of ground motion and of structural failure of the different components given a specific earthquake are first studied. The first of these is termed probability of exceedance and the second as seismic fragility analysis. The seismic fragility analysis is then related to the ground motion measured in terms of "g" to obtain a plant level fragility curve.

21611 (JAERI-M–94-030) **Experimental data report for Test TS-4: Reactivity Initiated Accident test in the NSRR with pre-irradiated BWR fuel rod.** Nakamura, Takehiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Yoshinaga, Makio; Ishijima, Kiyomi; Kobayashi, Shinsho; Yamahara, Takeshi; Sukegawa, Tomohide; Kikuchi, Teruo; Sobajima, Makoto. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 111p. Order Number DE94770638. Source: OSTI; NTIS; INIS.

This report presents experimental data for Test TS-4 which was the fourth test in a series of Reactivity Initiated Accident (RIA) test using pre-irradiated BWR fuel rods, performed in the Nuclear Safety Research Reactor (NSRR) in January, 1991. Test fuel rod used in the Test TS-4 was a short-sized BWR (7x7) type rod which was re-fabricated from a commercial rod irradiated in the Tsuruga Unit 1 power reactor of Japan Atomic Power Co. The fuel had an initial enrichment of 2.79% and a burnup of 26GWd/tU. A pulse irradiation of the test fuel rod was performed under a cooling condition of stagnant water at atmospheric pressure and at ambient temperature which simulated a BWR's cold start-up RIA event. The nominal energy deposition of 110±5 cal/g·fuel (89±4 cal/g·fuel) in peak fuel enthalpy) was subjected to the test fuel rod and no fuel failure was observed in the test. Descriptions on test conditions, test procedures, transient behavior of the test rod during the pulse irradiation, and results of pre-pulse and post-pulse irradiation examinations are described in this report. (author).

21612 (JAERI-M–94-031) **Simulation of irradiated BWR fuel rod (TS) test in NSRR using FRAP-T6 and NSR-77.** Nakamura, Takehiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Murofushi, Akira; Hosoyamada, Ryuji. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 162p. (In Japanese). Order Number DE94770639. Source: OSTI; NTIS; INIS.

Series of pulse irradiation tests have been performed in the Nuclear Safety Research Reactor (NSRR) to investigate irradiated fuel rod performance under the Reactivity Initiated Accident (RIA) conditions. Five tests, called Tests TS-1 through TS-5, were conducted in a period from 1989 to 1993 with irradiated 7x7 type BWR fuel rods provided from a commercial power plant. Simulation calculations of the TS tests were carried out with the FRAP-T6 code, which is widely used in the world to estimate fuel performance under various accident conditions, and with the NSR77 code, which describes fresh fuel rod performance well in the NSRR tests. Results of the calculation are compiled in this report and applicability of the codes to the irradiated BWR fuel rod tests is discussed. (author).

21613 (NUREG–0090-Vol.16-No.4) **Report to Congress on abnormal occurrences, October–December 1993: Volume 16, No. 4.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data. Apr 1994. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; GPO.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event that the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from October 1 through December 31, 1993. This report discusses six abnormal occurrences at NRC-licensed facilities. Five involved medical brachytherapy misadministrations, and one involved an overexposure to a nursing infant. Seven abnormal occurrences that were reported by the Agreement States are also discussed, based on information provided by the Agreement States as of February 28, 1994. Of these events, three involved brachytherapy misadministrations, one involved a teletherapy misadministration, one involved a theft of radioactive material during transport and improper disposal, and two involved lost sources.

21614 (NUREG–1125-Vol.15) **A compilation of reports of the Advisory Committee on Reactor Safeguards: 1993 annual: Volume 15.** Nuclear Regulatory Commission, Washington, DC (United States). Advisory Committee on Reactor Safeguards. Apr 1994. 141p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This compilation contains 47 ACRS reports submitted to the Commission, Executive Director for Operations, or to the Office of Nuclear Regulatory Research, during calendar year 1993. It also includes a report to the Congress on the NRC Safety Research Program. All reports have been made available to the public through the NRC Public Document Room and the US Library of Congress. The reports are categorized by the most appropriate generic subject area and by chronological order within subject area.

21615 (NUREG/CP–0127, pp. 1-13) **High pressure corium melt quenching tests.** Magallon, D. (Joint Research Centre, Safety Technology Institute, Ispra (Va) (Italy)); Hohmann, H. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The paper presents and discusses the first of a kind experimental data concerning the quenching of large masses of corium melt of realistic composition when poured into pressurized water at reactor scale depths. The tests involved 18 and 44 kg of a molten mixture 80 w% UO_2 - 20 w% ZrO_2, which were delivered by gravity through a nozzle of diameter 100 mm to 1m depth nearly saturated water at 5.0 MPa (i.e. around 263°C). The objective was to gain early information on the melt/water quench process previous to tests that will involve larger masses of melt (150 kg of mixtures UO_2-ZrO_2-Zr). Particularly, pressures and temperature were measured both in the gas phase and in the water. The results show that significant quenching occurred during the melt fall stage with 35% of the melt energy transferred to the water and 15% used for steam generation. About 2/3 of the melt fragmented in particles of mean size of the order of 4.0 mm. The remaining 1/3 collected still molten in the debris catcher but did not produce any damage to the bottom plate. The maximum downward heat flux was 0.8 MW/m^2. the maximum vessel overpressurization, i.e. 1.8 MPa, was recorded with 44 kg of melt poured into 255 kg of water and cover gas volume of 0.875 m^3. No steam explosions occurred.

21616 (NUREG/CP–0127, pp. 14-26) **Analysis of large-scale melt-water mixing events.** Jacobs, H. (Institut fuer Neutronenphysik und Reaktortechnik, Karlsruhe (Germany)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The transient multiphase multicomponent threefield hydrodynamics code IVA3 that is being developed at KfK Karlsruhe is used to analyse large-scale melt-water mixing events that have been observed in the FARO LWR facility at JRC Ispra and the BETA facility at KfK Karlsruhe. In the case of the FARO tests encouraging agreement between experiment and calculations is found.

21617 (NUREG/CP–0127, pp. 27-36) **Calculations of the premixing phase of an FCI with the trio MC code.** Berthoud, G. (Commissariat a l'Energie Atomique, C.E.N.G., Grenoble (France)); Valette, M. Nuclear Regulatory Commission, Washington, DC

(United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

A transient, three-dimensional, four field model is under development to deal with the premixing of large amounts of molten corium falling down in the lower plenum of a PWR. Calculation of the FARO Scoping test are presented with the two-dimensional, three field version of TRIO MC.

21618 (NUREG/CP–0127, pp. 37-53) **Ex-vessel melt-coolant interactions in deep water pool: Studies and accident management for Swedish BWRs.** Sienicki, J.J. (Argonne National Lab., IL (United States)); Chu, C.C.; Spencer, B.W.; Frid, W.; Loewenhielm, G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

In Swedish BWRs having an annular suppression pool, the lower drywell beneath the reactor vessel is flooded with water to mitigate against the effects of melt release into the drywell during a severe accident. The THIRMAL code has been used to analyze the effectiveness of the water pool to protect lower drywell penetrations by fragmenting and quenching the melt as it relocates downward through the water. Experiments have also been performed to investigate the benefits of adding sufactants to the water to reduce the likelihood of fine-scale debris formation from steam explosions. This paper presents an overview of the accident management approach and surfactant investigations together with results form the THIRMAL analyses.

21619 (NUREG/CP–0127, pp. 54-69) **Breakup of melt jets as pre-condition for premixing: Modeling and experimental verification.** Buerger, M. (Univ. of Stuttgart (Germany)); Cho, S.H.; Berg, E.V.; Schatz, A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The breakup of jets of melt in water pools constitutes a central problem in the frame of severe LWR accidents, influencing further accident progression. Especially, the mixing behavior of molten core material with water and thus the possibility of strong vapor explosions or the mode of contact of core material with the lower plenum structures are determined by this. For evaluating available modeling approaches on jet breakup the model developed at the IKE has been applied to experiments with jets of low melting Wood's metal in water performed at IKE, ANL and JRC Ispra. From variations of essential modeling features conclusions on different approaches are drawn. In principle, the mechanism of stripping at the jet column due to shear flow produced waves appears to explain the experiments, if based on the Miles formulation of the instability. Application to corium jets under vapor film boiling leads to much more stable coherent jet cores than based on the Kelvin-Helmholtz formulation and to much less fragmentation.

21620 (NUREG/CP–0127, pp. 70-88) **Validation of CHYMES: Simulant studies.** Hall, R.W. (Berkeley Technology Centre Berkeley (United Kingdom)); Fletcher, D.F. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The CFD code CHYMES models the initial mixing between core material and water in the lower plenum of a PWR. This paper reviews experiments to validate the code being carried out by Nuclear Electric and Oxford University. These experiments use isothermal and hot simulant fluids and particles in a thin-tank geometry to aid flow visualisation. Comparison with CHYMES calculations (made at Culham Laboratory) shows that the code underpredicts the spreading in these experiments. It is believed that turbulent flow fields are assisting spreading, and that the accumulation of vapour in the wakes of hot droplets may be increasing the coupling between the phases.

21621 (NUREG/CP–0127, pp. 89-98) **Validation of the CHYMES mixing model.** Fletcher, D.F. (SRD, AEA Technology, Culham Lab., Oxon (United Kingdom)); Denham, M.K. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

This paper contains a discussion of the work being performed in the UK to validate the CHYMES coarse mixing model. Attention is focussed on the MIXA experiments performed at Winfrith Technology Centre in which 3 kg of molten fuel simulant were released into water. The validation of CHYMES against one of these experiments (MIXA06) is discussed in detail. It is concluded that CHYMES can reproduce some features of the experiment (such as the existence of steam chimney around the mixture and the steam production rate within a factor of two) but it does not predict the observed mixture development (the radial spreading and the deceleration of the first melt arriving at the surface) well. Additional model development and experimental analysis underway to resolve these differences is discussed.

21622 (NUREG/CP–0127, pp. 99-133) **Premixing-related behavior of steam explosions.** Angelini, S. (Univ. of California, Santa Barbara, CA (United States)); Yuen, W.W.; Theofanous, T.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. Contract 04-89-084. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Three recently published premixing experiments, the MAGICO, MIXA, and FARO, are discussed comparatively, and two of them, the MAGICO and FARO, are analyzed with the help of the computer code PM-ALPHA. The results of these analyses are shown to provide quantitative interpretations of the data, and to suggest conditions/measurements in further experiments to enhance the insights thus obtained. Also, a quantitative radiography technique is described and applied to MAGICO for the measurement of chordal-averaged void fractions in the mixing zone. The results are in excellent agreement with PM-ALPHA predictions, thus confirming the previously reported good comparisons with the local (point) measurements of FLUTE.

21623 (NUREG/CP–0127, pp. 134-141) **A thermodynamic model for aluminium-water interactions.** McCahan, S. (Univ. of Toronto, Ontario (Canada)); Shepherd, J.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The thermodynamic aspects of the explosive interaction between aluminum and water are modeled computationally. The general model used in this investigation is an extension of the one used in previous work, (McCahan & Shepherd, Shepherd et al.). The flow is considered steady and one-dimensional and the reaction wave is captured in a control volume. The metal oxidation reaction is taken into account and the Rankine-Hugoniot relation is solved in conjunction with suitable equations of state for each component. A variety of upstream conditions were investigated to examine the effect on the solution curve, and more specifically the effect on the Chapman-Jouguet solution. The initial temperature of the aluminum, the initial vapor quality of the water and the amount of excess water were varied. Changing the initial temperature of the aluminum has very little effect, however, changing amount of water and the vapor quality significantly effect the CJ solution.

21624 (NUREG/CP–0127, pp. 142-147) **On the requirements for energetic molten aluminum-water chemical reaction.** Fauske, H.K. (Fauske & Associates, Inc., Burr Ridge, IL (United States)); Epstein, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

An explanation is provided for the large difference in noted chemical oxidation between the SL-1 accident (1-2% oxidation) and recent aluminum-water pour type experiments (20-30% oxidation). A simple model of the steam explosion reaction zone is developed and shows that the presence of significant voids in the premixture prior to the explosive event is required in order to produce significant oxidation potential on an explosive time scale. Such voids would be largely absent in unprotected accident scenarios similar to the SL-1 accident.

21625 (NUREG/CP–0127, pp. 148-158) **Propagation of vapor explosion in a stratified geometry experiments with liquid nitrogen and water.** Sainson, J. (Gaz de France, Nantes (France)); Gabillard, M.; Williams, T. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

An experimental investigation relative to liquid Nitrogen/water interaction at large laboratory scale is described in this paper. The self-sustained propagation of a triggered vapor explosion for this liquid pair was never attained in an initially well-stratified geometry. The interaction was always limited to the triggered zone which varied as a function of the different parameters of the experiment (trigger characteristics, Liquid Nitrogen layer thickness). However, experiments suggested that an increase of the initial wavyness of the liquid Nitrogen/water interface prior to triggering, was a sufficient condition to sustain the vapor explosion all along the ring.

21626 (NUREG/CP–0127, pp. 159-172) **Effect of boundary conditions on the propagation of a vapor explosion in stratified molten tin/water systems.** Frost, D.L. (McGill Univ., Montreal, Quebec (Canada)); Brucker, B.; Ciccarelli, G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The propagation of a vapor explosion in a stratified molten tin-water system has been investigated experimentally in three different configurations: (i) linear propagation in a narrow channel open at the top, (ii) propagation in a narrow channel with vertical confinement, and (iii) radial propagation in a cylindrical tank. In each case an interaction is initiated by an exploding wire trigger, and self-sustained spatial propagation of the interaction is observed to occur with an average propagation speed of 40-50 m/s. A minimum degree of inertial confinement provided by the water above the tin is required to sustain a propagating interaction. In the narrow channel experiments, the effective mixing depth for the interaction is $\leq$ 2 mm. The thermodynamic efficiency of the first interaction, or the ratio of the conversion ratio to the maximum thermodynamic conversion ratio, is about 1% and is not strongly dependent on the boundary conditions. A comparison between the energetics of single molten tin drop interactions and interaction in the stratified systems suggests that similar dynamic processes occur during the first interaction cycle in each case. In both cases, the first interaction is an efficient method for mixing the tin and water and is often a precursor to a second, more violent interaction.

21627 (NUREG/CP–0127, pp. 173-179) **Externally triggered steam explosion experiments: Amplification or propagation?.** Henry, R.E. (Fauske & Associates, Inc., Burr Ridge, IL (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

A vapor explosion is the rapid exchange of energy between a hot and cold liquid caused by, and resulting in, the propagation of shock waves through the liquid-vapor mixture. Many vapor explosion experiments have been performed using an external trigger to initiate the event. In general, the assessment of the explosive behavior has been to report the pressure history resulting from the "explosive interaction". However, with the mutual dispersion of high temperature liquid within the colder temperature host liquid, the pre-mixed configuration represents substantial stored energy. With the imposition of an external trigger to fragment and rapidly mix the debris, some of this stored energy could be released without causing propagation of the event. This paper discusses the difference between amplification of a trigger pulse due to the release of stored energy and propagation of the explosion within the premixed zone. Also, a criterion for deciding if propagation has occurred is provided. It is recommended that if the experiments do not satisfy this criterion, propagation of the event should not be concluded and the results should not be considered as a large scale explosion. Rather such data should be considered as a characterization of what could occur within an explosion if an explosion (shock wave) could be initiated.

21628 (NUREG/CP–0127, pp. 180-192) **Propagation investigations using the CULDESAC model.** Fletcher, D.F. (SRD, AEA Technology, Oxon (United Kingdom)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

This paper contains a description of the CULDESAC propagation model, which has been developed at Culham Laboratory, and a summary of results from a number of computational studies. The conservation equations which make up the model are described, together with the fragmentation and heat transfer models used to close it. Example results are then presented which illustrate the importance of solution parameters, the heat transfer and fragmentation models, and geometrical considerations on the calculated propagation behaviour. The difficulties in comparing model predictions with the available experimental data are then discussed. Finally, a summary of what are believed to be the important issues in propagation modelling is presented.

21629 (NUREG/CP–0127, pp. 193-203) **FCI experiments in the aluminumoxide/water system.** Hohmann, H. (Joint Research Centre, Ispra (Italy)); Magallon, D.; Schins, H.; Yerkess, A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of

Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The KROTOS facility at JRC Ispra was recently used to study experimentally melt-coolant premixing and steam explosion phenomena in Al_2O_3 - water mixtures with 1,5 kg melt at 2300 - 2400°C. In the five tests performed the main parameter was the water subcooling, 10,40 and 80 K, respectively. In the nearly saturated system, steam explosions could be externally triggered, which resulted in high (supercritical) explosion pressures in the test tube: Krotos 26, 28. Without triggering, melt penetration in water and melt agglomeration on the bottom plate of the test tube could be observed, which gave rise to strong steaming during the melt cooling-down process: KROTOS 27. In the two tests KROTOS 29,30, performed with 80 K subcooled water, self-triggered steam explosions occurred with pressures of more than 100 MPa. Post-test analysis of the debris revealed that 85 % of the interacting fuel mass fragmented in particles of sizes smaller than 250 μ. An energy conversion ratio of 1.25 % was estimated from vessel pressurization data taking into account the energy content in the fuel mass which broke up to particle diameters of less than 250 μ. The test section was damaged in the test KROTOS 30.

21630 (NUREG/CP–0127, pp. 204-217) **Modelling of the complete process of one-dimensional vapor explosions.** Tang, Jian (Univ. of Wisconsin, Madison, WI (United States)); Corradini, M.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Due to limited data and experimental scale limitations, simulation modelling is needed for better understanding of the vapor explosion. This paper presents a computer model, TEXAS-III capable of simulating the process of a one-dimensional vapor explosion. To develop such a model, an explosion fragmentation model for the propagation phase is essential. A semi-empirical fragmentation model based upon the mechanism of film collapse and coolant jet penetration was formulated and incorporated into the overall TEXAS model. This fragmentation model considers the fuel fragmentation rate as a function of the local pressure difference and the fuel interfacial surface area in film boiling with the coolant. This fragmentation model is combined with the TEXAS-II code, a hydrodynamics model for fuel-coolant mixing and fuel dynamic break-up due to relative velocity between the phases. This allows for a consistent mixing-explosion simulation. The model was used to analyze the experiment KROTOS-21 performed at JRC-Ispra and compared to the data. The simulation models the experiment starting from the fuel pouring into the coolant. The calculated pressure propagation speed and pressure profiles are compared with the liquid phase pressure data along with the fragmented debris and the gas phase pressure in the surrounding containment. In addition post-test blind calculations are presented for a recent aluminum-oxide/water test conducted at the JRC Ispra.

21631 (NUREG/CP–0127, pp. 218-232) **Stepwise verification of thermal detonation models: Examination by means of the KROTOS experiments.** Buerger, M. (Univ. of Stuttgart, Stuttgart (Germany)); Buck, M.; Mueller, K.; Schatz, A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

This paper picks up a verification line which has been started in an earlier publication with analyses on triggered thermal detonation experiments in the KROTOS facility. Improvements and extensions performed meanwhile in the thermal detonation code IDEMO as well as present results obtained with the improved code are described. New calculations on tin/H_2O experiments and a first calculation for experiments with an Al_2O_3/H_2O system are presented. The comparison of computational results with calculations of other authors for the tin/H_2O experiments shows that the experimental results can in principle be reproduced by two different approaches, both introducing however rather extreme assumptions. From these observations it can be concluded, that further progress in code development and verification requires specific checks between different codes and working out of determining features such as the fragmentation process and non-equilibrium effects in water heating and steam production. Further, the calculations and comparison lead to more specific requirements for experimental checks.

21632 (NUREG/CP–0127, pp. 233-250) **The prediction of 2D thermal detonations and resulting damage potential.** Yuen, W.W. (Univ. of California, Santa Barbara, CA (United States)); Theofanous, T.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. Contract 04-89-082. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The main purpose of this paper is to introduce a new concept for the processes responsible for the escalation and propagation of steam explosions. The concept recognizes that initially only a small quantity of coolant around each coarsely premixed melt mass "sees" the fragmenting debris coming off it, hence it is called the concept of "microinteractions." The authors also derive the analytical basis for it, define the nature of the requisite constitutive laws and related experimental data, and demonstrate that this concept is essential for the prediction of steam explosion energetics in large-scale premixtures in 2D geometries. They also provide the first numerical illustrations of this concept, implemented in the computer code ESPROSE.m. Further, they provide the first numerical results of steam explosions in large water pools, i.e., ex-vessel explosions. These results reveal two important mechanisms for explosion "venting" and thus for reducing the dynamic loads on adjacent structures. They conclude that, taken together, the "microinteractions" and "venting" make realistic predictions of steam explosion loads feasible and within reach in the near future.

21633 (NUREG/CP–0127, pp. 251-258) **Effects of surfactants on the likelihood and severity of steam explosions.** Kowal, M.G. (Northeast Utility Company, Hartford, CT (United States)); Dowling, M.F.; Abdel-Khalik, S.I. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Dilute aqueous solutions of two surface active agents (surfactants) were tested for their ability to suppress spontaneous steam explosions. Nonylphenol polyethylene glycol ether (Tergitol NP-9), a non-ionic surfactant, and dodecylbenzene sulfonate sodium salt (Witconate-90), an ionic surfactant, were used to prepare aqueous solutions with surfactant concentrations of 5, 10, and 50 wppm. Twelve grams of tin metal at 800°C and atmospheric pressure was dropped into a vessel containing 6 liters of deionized water, or one of the listed solutions. The experiments were repeated a minimum of twenty times with each coolant to check for consistency and repeatability. The peak pressures recorded for each experiment were statistically analyzed and compared with those for deionized water. Additionally, particle size distribution of the fragmented debris were measured and statistically analyzed. It was found that the surfactants do, indeed, mitigate the severity of vapor explosions. On

average, the surfactant solutions resulted in a 65% reduction in average peak pressures when compared with the deionized water results. However, very little difference in the mitigating effect of the surfactant solutions was observed as the concentration was increased beyond 5 wppm. The particle size distribution results also indicated a mitigating effect on steam explosion severity, as a 19% reduction in participating melt mass fraction was observed when the surfactants were used. For the peak pressure and particle size distributions results obtained, statistical analyses showed that the differences between the water and the surfactant experiments were significant. When comparing the surfactant solutions amongst themselves, however, the differences were not statistically significant.

21634 (NUREG/CP–0127, pp. 259-270) **Steam explosions of single drops of pure and alloyed molten aluminum.** Nelson, L.S. (Sandia National Labs., Albuquerque, NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Studies of steam explosion phenomena have been performed related to the hypothetical meltdown of the core and other components of aluminum alloy-fueled production reactors. The authors objectives were to characterize the triggers, if any, required to initiate these explosions and to determine the energetics and chemical processes associated with these events. Three basic studies have been carried out with 1 to 10 g single drops of molten aluminum or aluminum-based alloys: untriggered experiments in which drops of melt were released into water, triggered experiments in which thermal-type steam explosions occurred, and one triggered experiment in which an ignition-type steam explosion occurred. In untriggered experiments, spontaneous steam explosions never occurred during the free fall through water of single drops of pure Al or of the alloys studied here. Moreover, spontaneous explosions never occurred upon or during contact of the globules with several underwater surfaces. When Li was present in the alloy, H_2 was generated as a stream of bubbles as the globules fell through the water, and also as they froze on the bottom surface of the chamber. In both the triggered steam explosions with drops of high purity Al and untriggered experiments with drops of Al-Li, only a few tens of cm^3 of hydrogen per gram of metal were generated; the extent of metal-water reaction was only a few percent at most. The information obtained from these studies with triggered and untriggered drops of molten aluminum-based alloys can be used directly in certain safety studies where hypothetical core or component meltdown occurs in a production reactor. Moreover, this information is consistent with recent advances in the understanding of single-drop steam explosion triggering and concepts of the development of larger scale steam explosions.

21635 (NUREG/CP–0127, pp. 271-281) **Studies on fuel coolant interactions during core melt accident of Nuclear Power Plants.** Yamano, N. (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken (Japan)); Sugimoto, J.; Maruyama, Y.; Soda, K. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Two series of experiments to investigate FCIs have been performed at JAERI. In the melt drop steam explosion experiments, melt simulating the molten core was dropped into a pool of water. Spontaneous steam explosion was suppressed when the falling melt was dispersed by an artificial device or the ambient pressure was increased to 1.6 MPa. In the molten core coolability experiments, water was poured onto the melt. Melt eruption which might have led to an explosive interaction was observed when subcooled water was poured through a pipe nozzle. The eruption was not found when the water was at near saturation temperature or supplied through a spray nozzle. Heat transfer characteristics from the melt to the overlying water was evaluated. Size distribution of the debris was investigated in both the experiments.

21636 (NUREG/CP–0127, pp. 282-295) **Studies on fuel-coolant interactions during a reactivity initiated accident of Nuclear Power Plant.** Fuketa, Toyoshi (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken (Japan)); Yamano, Norihiro; Inoue, Akira. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

During a reactivity initiated accident (RIA) a large and prompt amount of energy is deposited within fuel rods. Consequent fuel melting and rod failure can lead to a fine dispersal of fuel melt in coolant, resulting in a violent thermal interaction between the fuel melt and coolant (i.e. fuel/coolant interaction–FCI). The generation of destructive forces during FCIs under RIA conditions have been demonstrated by the in-pile experiment program in Japan Atomic Energy Research Institute. The FCIs in an RIA have been also studied in Tokyo Institute of Technology by out-of-pile experiments and analytical modeling. The outlines and primary results of both the programs are described and discussed in this paper.

21637 (NUREG/CP–0127, pp. 296-308) **Safety issues related to fuel-coolant interactions in BWR's.** Okkonen, T. (Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland)); Hyvaerinen, J.; Haule, K. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

The need to understand the physics of fuel-coolant interactions (FCI's) is due to the fact that all severe accidents of light water reactors involve hot material (fuel) attacking water (coolant), or vice versa. In this paper, the boiling water reactors (BWR's) are examined. In addition to the steam explosion loads after core melt pouring into a water pool, FCI's are related to other mechanisms that may threaten containment of a severe accident. The two examples analysed in this paper are the effect of in-vessel coolant behaviour on BWR core degradation and recriticality, and the sensitivity of BWR containments to steam and non-condensible gas generation. As an overall conclusion, gas generation, coolant hydraulics and melt quenching during FCI's play a crucial role in the progression, and the success in management, of a severe BWR accident.

21638 (NUREG/CP–0127, pp. 309-321) **Quantification of the probability of containment failure caused by an in-vessel steam explosion for the Sizewell B PWR.** Turland, B.D. (SRD, AEA Technology, Oxon (United Kingdom)); Fletcher, D.F.; Hodges, K.I.; Attwood, G.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

AEA Technology has provided an assessment of the probability of α-mode containment failure for the Sizewell B PWR. After a preliminary review of the methodologies available it was decided to use the probabilistic approach described in the paper, based on an extension of the methodology developed by Theofanous et al. The input to the assessment is 12 probability distributions; the bases for the quantification of these distributions are discussed. The α-mode assessment performed for the Sizewell B PWR has demonstrated the practicality of the event-tree method with input

data represented by probability distributions. The assessment, itself, has drawn attention to a number of topics, which may be plant and sequence dependent, and has indicated the importance of melt relocation scenarios. The α-mode failure probability following an accident that leads to core melt relocation to the lower head for the Sizewell B PWR has been assessed as a few parts in tenthousand, on the basis of current information. This assessment has been the first to consider elevated pressures (6 MPa and 15 MPa) besides atmospheric pressure, but the results suggest only a modest sensitivity to system pressure.

21639 (NUREG/CP–0127, pp. 322-329) **Steam explosion research at Kernforschungszentrum Karlsruhe.** Jacobs, H. (Institut fuer Neutronenphysik und Reaktortechnik, Karlsruhe (Germany)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

A research program has been set up at Kernforschungszentrum Karlsruhe with the aim to determine realistic upper bounds to the loads on components of the containment of a large pressurized water reactor in case of a core melt down accident. This research is part of an attempt to find out whether the containments of such reactors can in the future be built in such a way that even the consequences of core melt down accidents are limited to the plant itself. After a short outline of the motivation for this venture, the plans of research correlated to in-vessel steam explosions are discussed.

21640 (NUREG/CP–0127, pp. 330-342) **The probability of alpha-mode containment failure updated.** Theofanous, T.G. (Univ. of California, Santa Barbara, CA (United States)); Yuen, W.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Nuclear Energy Agency, 75 - Paris (France); California Univ., Santa Barbara, CA (United States). Center for Risk Studies and Safety. Mar 1994. Contract 04-89-082. (NEA/CSNI/R–(93)8; CONF-930157–: Specialist meeting on fuel-coolant interactions, Santa Barbara, CA (United States), 5-7 Jan 1993). In *Proceedings of the CSNI specialists meeting on fuel-coolant interactions.* 370p. Source: OSTI; NTIS; INIS; GPO.

Since the original quantification of the likelihood of α failure in NUREG/CR-5030, major experimental and analytical developments have taken place. By taking advantage of these development, the authors believe it is possible to reduce the substantial conservatisms in the original quantification, and to thus conclude that even vessel failure by steam explosions may be regarded as physically unreasonable. They have illustrated how this can be done within the original framework, as well as in a complementary framework that takes advantage of current integral analysis capabilities. On this basis, the α-failure issue is now ripe for final resolution; what is needed is a complete set a calculations supporting a revised quantification of CR1 and CR3 and a final review step in the ROAAM process.

21641 (NUREG/CP–0133-Vol.1) **Proceedings of the Twenty-First Water Reactor Safety Information Meeting: Volume 1, Plenary session; Advanced reactor research; advanced control system technology; advanced instrumentation and control hardware; human factors research; probabilistic risk assessment topics; thermal hydraulics; thermal hydraulic research for advanced passive LWRs.** Monteleone, S. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1994. 586p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (CONF-931079–Vol.1: 21. water reactor safety information meeting, Bethesda, MD (United States), 25-27 Oct 1993). Source: OSTI; NTIS; INIS; GPO.

This three-volume report contains 90 papers out of the 102 that were presented at the Twenty-First Water Reactor Safety Information Meeting held at the Bethesda Marriott Hotel, Bethesda, Maryland, during the week of October 25–27, 1993. The papers are printed in the order of their presentation in each session and describe progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included papers presented by researchers from France, Germany, Japan, Russia, Switzerland, Taiwan, and United Kingdom. The titles of the papers and the names of the authors have been updated and may differ from those that appeared in the final program of the meeting. Individual papers have been cataloged separately. This document, Volume 1 covers the following topics: Advanced Reactor Research; Advanced Instrumentation and Control Hardware; Advanced Control System Technology; Human Factors Research; Probabilistic Risk Assessment Topics; Thermal Hydraulics; and Thermal Hydraulic Research for Advanced Passive Light Water Reactors.

21642 (NUREG/CP–0133-Vol.2) **Twenty-First Water Reaction Safety Information Meeting: Volume 2, Severe accident research.** Monteleone, S. (comp.) (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1994. 611p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (CONF-931079–Vol.2: 21. water reactor safety information meeting, Bethesda, MD (United States), 25-27 Oct 1993). Source: OSTI; NTIS; INIS; GPO.

This three-volume report contains 90 papers out of the 102 that were presented at the Twenty-First Water Reactor Safety Information Meeting held at the Bethesda Marriott Hotel, Bethesda, Maryland, during the week of October 25–27, 1993. The papers are printed in the order of their presentation in each session and describe progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included papers presented by researchers from France, Germany, Japan, Russia, Switzerland, Taiwan, and United Kingdom. The titles of the papers and the names of the authors have been updated and may differ from those that appeared in the final program of the meeting. Individual papers have been cataloged separately. This document, Volume 2, presents papers on severe accident research.

21643 (NUREG/CR–5359) **Review of elastic stress and fatigue-to-failure data for branch connections and tees in relation to ASME design criteria for nuclear power piping systems.** Rodabaugh, E.C.; Moore, S.E.; Gwaltney, R.C. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Oak Ridge National Lab., TN (United States). May 1994. 120p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–11152). Source: OSTI; NTIS; INIS; GPO.

This is the third in a series of reports on the state-of-the art design guidance for piping system branch connections and tees provided by Section III of the ASME Boiler and Pressure Vessel Code. The other reports covered primary or limit-loads and nozzle flexibility. The principal objective of this report, as with the others, was to identify and collect the pertinent literature on the the subject and to identify needed improvements in the design methods and criteria of the Code based on the evaluation of the available information. This report does not propose changes in the design procedure of the Code. This report discusses the evaluation of stresses in branch connections and tees, correlation of these stresses with fatigue failures, and the Code rules for protection against fatigue failure in design applications. Because of the extensive amount of available information, the report was divided into two parts. Part I discusses cyclic internal pressure loading and Part II discusses moment loadings for the branch and run. The cyclic pressure loading fatigue parameters are mostly based on leakage, whereas, if the parameters were based on crack initiation, different and possibly higher valves would be developed. The fatigue evaluation procedure, which attempts to relate fatigue strength of piping components to strain-controlled, polished bar, and fatigue data appears to be inaccurate on the conservative side for high amplitude cycles and inaccurate on the unconservative side for low amplitude cycles. The report proposes additional analytical and experimental work.

21644 (NUREG/CR–5939) **The effects of age on nuclear power plant containment cooling systems.** Lofaro, R. (Brookhaven National Lab., Upton, NY (United States)); Subudhi, M.; Travis, R.; DiBiasio, A.; Azarm, A.; Davis, J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Brookhaven National Lab., Upton, NY (United States); Science Applications International Corp., New York, NY (United States). Apr 1994. 145p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52345). Source: OSTI; NTIS; INIS; GPO.

A study was performed to assess the effects of aging on the performance and availability of containment cooling systems in US commercial nuclear power plants. This study is part of the Nuclear Plant Aging Research (NPAR) program sponsored by the US Nuclear Regulatory Commission. The objectives of this program are to provide an understanding of the aging process and how it affects plant safety so that it can be properly managed. This is one of a number of studies performed under the NPAR program which provide a technical basis for the identification and evaluation of degradation caused by age. The effects of age were characterized for the containment cooling system by reviewing and analyzing failure data from national databases, as well as plant-specific data. The predominant failure causes and aging mechanisms were identified, along with the components that failed most frequently. Current inspection, surveillance, and monitoring practices were also examined. A containment cooling system unavailability analysis was performed to examine the potential effects of aging by increasing failure rates for selected components. A commonly found containment spray system design and a commonly found fan cooler system design were modeled. Parametric failure rates for those components in each system that could be subject to aging were accounted for in the model to simulate the time-dependent effects of aging degradation, assuming no provisions are made to properly manage it. System unavailability as a function of increasing component failure rates was then calculated.

21645 (NUREG/CR–5960) **Steam explosions: Fundamentals and energetic behavior.** Theofanous, T.G. (California Univ., Santa Barbara, CA (United States). Dept. of Chemical and Nuclear Engineering); Yuen, W.W.; Angelini, S.; Chen, X.; Amarasooriya, W.H.; Medhekar, S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; California Univ., Santa Barbara, CA (United States). Dept. of Chemical and Nuclear Engineering. Jan 1994. 284p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report presents the results of a multifaceted research effort in the field of steam explosions. The scope ranges from the fundamentals to assessing the energetics in applications relevant to Severe Accidents in Light Water Reactors. The consideration of fundamentals is built around two key ideas: the water depletion phenomenon during premixing and the microinteractions, including fragmentation kinetics, during propagation. The application to reactor conditions includes consideration of in-vessel steam explosions in PWRs and ex-vessel explosions in all five containment designs in current plants (in the USA). The report is structured in three parts, dealing with premixing, propagation, and energetics, respectively.

21646 (NUREG/CR–6044) **Experiments to investigate direct containment heating phenomena with scaled models of the Zion Nuclear Power Plant in the Surtsey Test Facility.** Allen, M.D. (Sandia National Labs., Albuquerque, NM (United States)); Pilch, M.M.; Blanchat, T.K.; Griffith, R.O.; Nichols, R.T. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (United States). May 1994. 209p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-94AL85000. (SAND–93-1049). Source: OSTI; NTIS; INIS; GPO.

The Surtsey Facility at Sandia National Laboratories (SNL) is used to perform scaled experiments that simulate hypothetical high-pressure melt ejection (HPME) accidents in a nuclear power plant (NPP). These experiments are designed to investigate the effect of specific phenomena associated with direct containment heating (DCH) on the containment load, such as the effect of physical scale, prototypic subcompartment structures, water in the cavity, and hydrogen generation and combustion. In the Integral Effects Test (IET) series, 1:10 linear scale models of the Zion NPP structures were constructed in the Surtsey vessel. The RPV was modeled with a steel pressure vessel that had a hemispherical bottom head, which had a 4-cm hole in the bottom head that simulated the final ablated hole that would be formed by ejection of an instrument guide tube in a severe NPP accident. Iron/alumina/chromium thermite was used to simulate molten corium that would accumulate on the bottom head of an actual RPV. The chemically reactive melt simulant was ejected by high-pressure steam from the RPV model into the scaled reactor cavity. Debris was then entrained through the instrument tunnel into the subcompartment structures and the upper dome of the simulated reactor containment building. The results of the IET experiments are given in this report.

21647 (NUREG/CR–6053) **Comparison of MACCS users calculations for the international comparison exercise on probabilistic accident consequence assessment code, October 1989–June 1993.** Neymotin, L. (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Brookhaven National Lab., Upton, NY (United States). Apr 1994. 169p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52380). Source: OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020.

Over the past several years, the OECD/NEA and CEC sponsored an international program intercomparing a group of six probabilistic consequence assessment (PCA) codes designed to simulate health and economic consequences of radioactive releases into atmosphere of radioactive materials following severe accidents at nuclear power plants (NPPs): ARANO (Finland), CONDOR (UK), COSYMA (CEC), LENA (Sweden), MACCS (USA), and OSCAAR (Japan). In parallel with this effort, two separate groups performed similar calculations using the MACCS and COSYMA codes. Results produced in the MACCS Users Group (Greece, Italy, Spain, and USA) calculations and their comparison are contained in the present report. Version 1.5.11.1 of the MACCS code was used for the calculations. Good agreement between the results produced in the four participating calculations has been reached, with the exception of the results related to the ingestion pathway dose predictions. The main reason for the scatter in those particular results is attributed to the lack of a straightforward implementation of the specifications for agricultural production and counter-measures criteria provided for the exercise. A significantly smaller scatter in predictions of other consequences was successfully explained by differences in meteorological files and weather sampling, grids, rain distance intervals, dispersion model options, and population distributions.

21648 (NUREG/CR–6094) **Calculations in support of a potential definition of large release.** Hanson, A.L.; Davis, R.E.; Mubayi, V. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). May 1994. 161p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52387). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission has stated a hierarchy of safety goals with the qualitative safety goals as Level I of the hierarchy, backed up by the quantitative health objectives as Level II and the large release guideline as Level III. The large release guideline has been stated in qualitative terms as a magnitude of release of the core inventory whose frequency should not exceed 10^{-6} per reactor year. However, the Commission did not provide a quantitative specification of a large release. This report describes various specifications of a large release and focuses, in particular, on an examination of releases which have a potential to lead to one prompt fatality in the mean. The basic information required to set up the calculations was derived from the simplified source terms which were obtained from approximations of the NUREG-1150 source terms. Since the calculation of consequences is affected by

a large number of assumptions, a generic site with a (conservatively determined) population density and meteorology was specified. At this site, various emergency responses (including no response) were assumed based on information derived from earlier studies. For each of the emergency response assumptions, a set of calculations were performed with the simplified source terms; these included adjustments to the source terms, such as the timing of the release, the core inventory, and the release fractions of different radionuclides, to arrive at a result of one mean prompt fatality in each case. Each of the source terms, so defined, has the potential to be a candidate for a large release. The calculations show that there are many possible candidate source terms for a large release depending on the characteristics which are felt to be important.

21649 (NUREG/CR–6104) **Shear wall ultimate drift limits.** Duffey, T.A. (Duffy, (T.A.) Tijeras, NM (United States)); Goldman, A.; Farrar, C.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Los Alamos National Lab., NM (United States). Apr 1994. 107p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA–12649-MS). Source: OSTI; NTIS; INIS; GPO.

Drift limits for reinforced-concrete shear walls are investigated by reviewing the open literature for appropriate experimental data. Drift values at ultimate are determined for walls with aspect ratios ranging up to a maximum of 3.53 and undergoing different types of lateral loading (cyclic static, monotonic static, and dynamic). Based on the geometry of actual nuclear power plant structures exclusive of containments and concerns regarding their response during seismic (i.e.,cyclic) loading, data are obtained from pertinent references for which the wall aspect ratio is less than or equal to approximately 1, and for which testing is cyclic in nature (typically displacement controlled). In particular, lateral deflections at ultimate load, and at points in the softening region beyond ultimate for which the load has dropped to 90, 80, 70, 60, and 50 percent of its ultimate value, are obtained and converted to drift information. The statistical nature of the data is also investigated. These data are shown to be lognormally distributed, and an analysis of variance is performed. The use of statistics to estimate Probability of Failure for a shear wall structure is illustrated.

21650 (NUREG/CR–6211) **Integrated Fuel-Coolant Interaction (IFCI 6.0) code: User's manual.** Davis, F.J. (Sandia National Labs., Albuquerque, NM (United States)); Young, M.F. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 57p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-94AL85000. (SAND–94-0406). Source: OSTI; NTIS; INIS; GPO.

The integrated Fuel-Coolant interaction (IFCI) computer code is being developed at Sandia National Laboratories to investigate the fuel-coolant interaction (FCI) problem at large scale using a two-dimensional, four-field hydrodynamic framework and physically based models. IFCI will be capable of treating all major FCI processes in an integrated manner. This document is a product of the effort to generate a stand-alone version of IFCI, IFCI 6.0. The User's Manual describes in detail the hydrodynamic method and physical models used in IFCI 6.0. Appendix A is an input manual, provided for the creation of working decks.

21651 (ORNL/M–3262) **A station blackout simulation for the Advanced Neutron Source Reactor using the integrated primary and secondary system model.** Schneider, E.A. (Cornell Univ., Ithaca, NY (United States)). Oak Ridge National Lab., TN (United States). [1994]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013600. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Neutron Source Reactor (ANSR) is a research reactor to be built at Oak Ridge National Laboratory. This paper deals with thermal-hydraulic analysis of ANSR's cooling systems during nominal and transient conditions, with the major effort focusing upon the construction and testing of computer models of the reactor's primary, secondary and reflector vessel cooling systems. The code RELAP5 was used to simulate transients, such as loss of coolant accidents and loss of off-site power, as well as to model the behavior of the reactor in steady state. Three stages are involved in constructing and using a RELAP5 model: (1) construction and encoding of the desired model, (2) testing and adjustment of the model until a satisfactory steady state is achieved, and (3) running actual transients using the steady-state results obtained earlier as initial conditions. By use of the ANSR design specifications, a model of the reactor's primary and secondary cooling systems has been constructed to run a transient simulating a loss of off-site power. This incident assumes a pump coastdown in both the primary and secondary loops. The results determine whether the reactor can survive the transition from forced convection to natural circulation.

21652 (ORNL/TM–12677) **Evaluation of the need for emergency heat exchangers for long term emergency cooling of the Advanced Neutron Source Reactor.** Khayat, M.I.; Anderson, J.L.; Battle, R.E.; March-Leuba, J. Oak Ridge National Lab., TN (United States). May 1994. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013193. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the work performed to evaluate the heat transferred to the light water pools from the primary piping system for the Advanced Neutron Source reactor (ANSR) conceptual design. It has been determined that the ANSR primary piping system will remove sufficient heat from the primary coolant system to the pools for certain design basis event accidents without the emergency heat exchangers if the design parameters, such as pool volumes and pipe sizes (length and surface area), are selected appropriately. Based on this analysis, the emergency heat exchangers might be removed, and their function can be performed by the primary piping passing through the light water pools described in the conceptual design report. This study also shows that connecting the pipe chase pool and the heat exchanger pools improve performance for ANSR emergency heat removal.

21653 (SAND–93-2275) **VICTORIA-92 pretest analyses of PHEBUS-FPT0.** Bixler, N.E.; Erickson, C.M. Sandia National Labs., Albuquerque, NM (United States). Jan 1994. 58p. Sponsored by USDOE, Washington, DC (United States);Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94008314. Source: OSTI; NTIS; INIS; GPO Dep.

FPT0 is the first of six tests that are scheduled to be conducted in an experimental reactor in Cadarache, France. The test apparatus consists of an in-pile fuel bundle, an upper plenum, a hot leg, a steam generator, a cold leg, and a small containment. Thus, the test is integral in the sense that it attempts to simulate all of the processes that would be operative in a severe nuclear accident. In FPT0, the fuel will be trace irradiated; in subsequent tests high burn-up fuel will be used. This report discusses separate pretest analyses of the FPT0 fuel bundle and primary circuit have been conducted using the USNRC's source term code, VICTORIA-92. Predictions for release of fission product, control rod, and structural elements from the test section are compared with those given by CORSOR-M. In general, the releases predicted by VICTORIA-92 occur earlier than those predicted by CORSOR-M. The other notable difference is that U release is predicted to be on a par with that of the control rod elements; CORSOR-M predicts U release to be about 2 orders of magnitude greater.

21654 (SAND–93-3949C) **Analysis of concrete containment structures under severe accident loading conditions.** Porter, V.L. Sandia National Labs., Albuquerque, NM (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406132–2: ABAQUS User's conference, Newport, RI (United States), 1-3 Jun 1994). Order Number DE94010398. Source: OSTI; NTIS; GPO Dep.

One of the areas of current interest in the nuclear power industry is the response of containment buildings to internal pressures that may exceed design pressure levels. Evaluating the response of structures under these conditions requires computing beyond design load to the ultimate load of the containment. For concrete containments, this requirement means computing through severe concrete cracking and into the regime of wide-spread plastic rebar and/or tendon response. In this regime of material response, an implicit code can have trouble converging. This paper describes some of the author's experiences with Version 5.2 of ABAQUS

Standard and the ABAQUS concrete model in computing the axisymmetric response of a prestressed concrete containment to ultimate global structural failure under high internal pressures. The effects of varying the tension stiffening parameter in the concrete material model and variations of the parameters for the CONTROLS option are discussed.

21655 (WHC-SA–2169) **Engineering studies for the Surplus Production Reactor Decommissioning Project at the Hanford Site.** Miller, R.L. (Westinghouse Hanford Co., Richland, WA (United States)); Powers, E.W.; Usher, J.M.; Yannitell, D.M. Westinghouse Hanford Co., Richland, WA (United States). Oct 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-931095–84: Department of Energy environmental remediation conference, Augusta, GA (United States), 24-28 Oct 1993). Order Number DE94011338. Source: OSTI; NTIS; INIS; GPO Dep.

In 1942, the Hanford Site (near Richland, WA) was commissioned as a facility for the production of plutonium. On location there are nine water cooled, graphite-moderated plutonium production reactors, which are now retired from service. Because the reactors contain irradiated reactor components, and because the buildings that house the reactors are contaminated with low levels of reactivity, the DOE has determined that there is a need for action and that some form of decommissioning or continued surveillance and maintenance is necessary. This report discusses assessments of the alternatives which have determined that while continued surveillance and maintenance adequately isolates remaining radioactive materials from the environment and properly protects human health and safety; decontamination and decommissioning (D&D) will ultimately be necessary. The project is technically complex and will likely be designated as a Department of Energy (DOE) Major System Acquisition or Major Project.

21656 (WSRC-RP–94-250) **Update of HB-line consequences based on new meteorological and population databases in AX-AIR89Q.** DelGenio, M.E. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012378. Source: OSTI; NTIS; GPO Dep.

Additional analyses and upgrading of the Safety Analysis Report (SAR) and Justification for Continued Operation (JCO) is needed for an Environmental Assessment (EA) currently being prepared for HB-Line. Since the JCO and SAR do not include population doses for two accidents; a propagated fire and a ground level release for an earthquake, this analysis will provide these doses. Population distribution information has been updated to 1992. This analysis will analyze the onsite worker at a distance of 640 meters from the release point using 50% meteorology in accordance with more recent DOE guidance. The doses will be calculated for all the accidents reported in the JCO. This analysis will update maximum offsite individual doses using a new meteorological database based on more recent data collected from 1987-1991. The new meteorological database results in a decrease in the dose from a release from H-Area.

21657 (WSRC-TR–92-534-Bk.1) **Experimental onset of flow instability testing by Creare, Inc. Book 1.** Coutts, D.A. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011250. Source: OSTI; NTIS; INIS; GPO Dep.

Flow excursions can occur during subcooled heated flow if the supply system is not adequate to meet the heated channel pressure demand. Available experimental flow instability (FI) data for ribbed annuli such as used in the SRS production reactors is very limited. Creare Inc. completed a series of FI tests which included two annular geometries; one of these included metallic ribs which separated the annulus into four sub-channels. This report summarizes the results of the onset of flow instability (OFI) testing which was completed by Creare in support of the SRS Reactor Restart Program. A copy of the final test report has been attached and the archival locations for the supporting documentation and electronic test data is also included. The purpose of this report is to: Archive the Creare Program data; inspect the data which has been archived; review the results presented by Creare; and evaluate if the Creare Program data may be used in critical applications.

21658 (WSRC-TR–92-534-Bk.2) **Nucleate boiling pressure drop in an annulus: Book 2.** Block, J.A.; Crowley, C.; Dolan, F.X.; Sam, R.G.; Stoedefalke, B.H. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011251. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. Nineteen test series and a total of 178 tests were performed. Testing addressed the effects of: Heat flux; pressure; helium gas; power tilt; ribs; asymmetric heat flux.

21659 (WSRC-TR–92-534-Bk.3) **Nucleate boiling pressure drop in an annulus: Book 3.** Block, J.A.; Crowley, C.; Dolan, F.X.; Sam, R.G.; Stoedefalke, B.H. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 327p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011252. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. This document consists of data plots and summary files of temperature measurements.

21660 (WSRC-TR–92-534-Bk.4) **Nucleate boiling pressure drop in an annulus: Book 4.** Block, J.A.; Crowley, C.; Dolan, F.X.; Sam, R.G.; Stoedefalke, B.H. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 379p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011253. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. This document consists of data plots and summary files of temperature measurements.

21661 (WSRC-TR–92-534-Bk.5) **Nucleate boiling pressure drop in an annulus: Book 5.** Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011254. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. Nineteen test series and a total of 178 tests were performed. Testing addressed the effects of: Heat flux; pressure; helium gas; power tilt; ribs; asymmetric heat flux. This document consists solely of the plato file index from 11/87 to 11/90.

21662 (WSRC-TR–92-534-Bk.6) **Nucleate boiling pressure drop in an annulus: Book 6.** Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 1131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011255. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. This document consists of a summary of temperature measurements to include recorded minima, maxima, averages and standard deviations.

21663 (WSRC-TR–92-534-Bk.7) **Nucleate boiling pressure drop in an annulus: Book 7.** Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 1033p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011256. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. This document consists solely of tables of temperature measurements; minima, maxima, averages and standard deviations being measured.

21664 (WSRC-TR–92-534-Bk.8) **Nucleate boiling pressure drop in an annulus: Book 8.** Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 1067p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011257. Source: OSTI; NTIS; INIS; GPO Dep.

The application of the work described in this report is the production reactors at the Savannah River Site, and the context is nuclear reactor safety. The Loss of Coolant Accident (LOCA) scenario considered involves a double-ended break of a primary coolant pipe in the reactor. During a LOCA, the flow through portions of the reactor may reverse direction or be greatly reduced, depending upon the location of the break. The reduced flow rate of coolant (D_2O) through the fuel assembly channels of the reactor – downflow in this situation – can lead to boiling and to the potential for flow instabilities which may cause some of the fuel assembly channels to overheat and melt. That situation is to be avoided. The experimental approach is to provide a test annulus which simulates geometry, materials, and flow conditions in a Mark-22 fuel assembly (Coolant Channel 3) to the extent possible. The annulus has a full-scale geometry, and in fat uses SRL dummy hardware for the inner annulus wall in the ribbed geometry. The materials aluminum. The annulus

is uniformly heated in the axial direction, but the circumferential heat flux can be varied to provide "power tilt" or asymmetric heating of the inner and outer annulus walls. The test facility uses H_2O rather than D_2O, but it includes the effects of dissolved helium gas present in the reactor. The key analysis approaches are: To compare the minima in the measured demand curves with analytical criteria, in particular the Saha-Zuber (1974) model; and to compare the pressure and temperature as a function of length in the annulus with an integral model for flow boiling in a heated channel. This document consists of tables of temperature measurements.

24 POWER TRANSMISSION AND DISTRIBUTION

2401 Power Systems

Refer also to citation(s) 22003

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 21211

21665 (DOE/EIS–0145(3/94)) **Non-federal participation capacity ownership. Administrator's record of decision.** USDOE Bonneville Power Administration, Portland, OR (United States). Mar 1994. 72p. Sponsored by USDOE, Washington, DC (United States). (DOE/BP–2332). Order Number DE94013092. Source: OSTI; NTIS; GPO Dep.

In a September 1988 Record of Decision (ROD), Bonneville Power Administration (BPA) explained its decision to proceed with the Third Alternating Current (Third AC) Intertie addition construction project using its own funding. At that time, BPA's decision on non-Federal ownership access to the added capacity was deferred to a separate non-Federal participation policy development process. BPA's preferred alternative for providing non-Federal Intertie access is to adopt Capacity Ownership for 725 MW. Capacity Ownership allows non-Federal PNW scheduling utilities to purchase contract rights to use protions of BPA's share of AC Intertie capacity for the life of the Intertie facilities. This ROD documents BPA's decision to proceed with Capacity Ownership for non-Federal parties.

21666 (KTM/E-B–172) **Electricity transmission in distribution networks: Background study for the electricity market act.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 84p. (In Finnish). Project KTM-36/881/93. Order Number DE94771068. Source: OSTI; NTIS.

Commissioned by Association of Finnish Electric Utilities.

This report surveys and compares different pricing models of electricity transmission in distribution networks and assesses their suitability in Finland. This survey deals with the following transmission pricing models: non-distance-dependent pricing in the whole distribution area non-distance-dependent pricing by districts, pricing by customers, distance-dependent pricing by line sections, distance-dependent pricing and zonal non-distance-dependent pricing. The report deals also with problems which are involved by the free electricity markets. The report offers some alternative operation models to make it possible for electricity markets and for the whole electricity supply system to act as well as possible in the future. The operation models which were dealt with are: a real time model, a part delivery model, two prior notice models and a load curve model. In the real time model customers of outside electricity dealers have metering which measures the energy accumulation of the current hour. They also have a data transmission connection on real time between the network company and electricity dealers. In the part delivery model the consumer buys one part of his electricity from an outside dealer and the rest from the local dealer. In this model a metering will be needed to register hourly meanload-values and to remote reading of metering. In the two prior notice models an outside dealer supplies electricity to its customers according to the advance notice. The metering is the same as in the part delivery model. The report deals also with the requirements for a metering system in different operation models and briefly also with agreements which are needed in the free electricity markets.

21667 (KTM/E-B–173) **Network pricing in the Finnish electricity supply industry.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 168p. Order Number DE94771067. Source: OSTI; NTIS.

Summary in Finnish 'Saehkoen siirron hinnoittelu - Saehkoemarkkinalain taustaselvitys'.

The Ministry of Trade and Industry commissioned London Economics in August 1993 to carry out a review of network pricing in the Finnish electricity supply industry (ESI) because network pricing will play a crucial role in the success of the Ministry's initiative to open the ESI to competition. Under the new Electricity Market Act, the transmission and distribution networks will be required to provide access to all potential users. But network access needs to be on a fair and nondiscriminatory basis and to be organised as simply as possible to ensure that competition in the market is both fair and efficient. The aim of this review is to assist the Ministry in ensuring, with the benefit of international experience, that the structure and organisation of transmission and distribution pricing are consistent with the aims of the new Act. This paper represents London Economics Final Report. The report contains: a statement of the importance of transmission pricing in competitively organised ESIs; an outline of the particular challenges for the Finnish ESI given its technical and institutional characteristics; a discussion of economic principles and a range of possible approaches to implementing transmission pricing systems; a comparison of Ivo Voimansiirto Oy's (IVS)S-2000 transmission prices with pricing practice in other countries which have undertaken reform in their ESIs: a critique of IVS's S-2000 pricing system in the light of the objectives of transmission pricing, economic principles and international best practice; a review of organisational and regulatory issues; and a brief analysis of distribution pricing in competitively organised ESIs.

2404 Health and Safety

Refer also to citation(s) 21665, 21764

21668 (DOE/BP-I–9351) **Rules of conduct for persons entering substations.** USDOE Bonneville Power Administration, Portland, OR (United States). Jan 1994. 22p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013389. Source: OSTI; NTIS; GPO Dep.

The following is a field orientation guide for unescorted entry and performance of work not affecting the electrical operation of the BPA power system. For further information on the following, please refer to the Accident Prevention Manual. The mandatory rules herein express minimum requirements for dealing with the principal hazards inherent in our daily work activities. These and other written requirements, which neither can nor should provide complete coverage of all work situations, must be continually reinforced through the sound and mature safety judgments of each BPA and contractor worker on each assigned task. The administration shall provide employment free from or protected against recognized hazards that might cause physical harm or death. The work environment must comply with Occupational Safety and Health Administration (OSHA), Departmental, and electrical utility industry standards applicable to BPA operations and activities. Supervisors shall insure that all workers fully understand how to perform their work with safety to themselves and others. They shall impart to each person the understanding that violations of established safety practices and rules will not be tolerated. Supervisors shall plan and arrange their work in such a manner that each job will be accomplished with the least hazard to workers; other persons, including the public, and to property. They will advise all workers of any unusual hazards involved in their part of the work and of precautions to be observed.

2405 Environmental Aspects

Refer also to citation(s) 21669

2406 Legislation and Regulations

Refer also to citation(s) 21664, 21666

2407 Economic, Industrial, and Business Aspects

21669 (DOE/EIA–0580) **Financial impacts of nonutility power purchases on investor-owned electric utilities.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 1 Jun 1994. 102p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013416. Source: OSTI; NTIS; INIS; GPO Dep.

To assist in its these responsibilities in the area of electric power, EIA has prepared this report, Financial Impacts of Nonutility Power Purchases on Investor-Owned Electric Utilities. The primary purpose of this report is to provide an overview of the issues surrounding the financial impacts of nonutility generation contracts (since the passage of the Public Utility Regulatory Policies Act of 1978) on investor-owned utilities. The existing concern in this area is manifest in the provisions of Section 712 of the Energy Policy Act of 1992, which required State regulatory commissions to evaluate various aspects of long-term power purchase contracts, including their impact on investor-owned utilities' cost of capital and rates charged to customers. The EIA does not take positions on policy questions. The EIA's responsibility is to provide timely, high quality information and to perform objective, credible analyses in support of the deliberations by both public and private decision-makers. Accordingly, this report does not purport to represent the policy positions of the US Department of Energy or the Administration.

21670 (DOE/EIS–0145(4/94)) **Non-federal participation federal marketing and joint ventures. Administrator's record of decision.** USDOE Bonneville Power Administration, Portland, OR (United States). Apr 1994. 20p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013093. Source: OSTI; NTIS; GPO Dep.

By this Record of Decision, the Bonneville Power Administrtion (BPA) adopts the Federal Marketing and Joint Ventures alternative to guide future BPA contract negotiations involving use of the Pacific Northwest-Pacific Southwest AC Intertie (Intertie). To implement this concept, BPa intends to negotiate an array of flexible, market-oriented contracts, expanded Intertie access for non-BPA parties, efficient use of Federal Columbia River resources, and facilitation of efficient, coordinated west coast development of generating resources. Federal Marketing and Joint Ventures meets need and serves purposes to a better degree than No Action. BPA considers Federal Marketing and Joint Ventures to be the environmentally preferable alternative in that it encourages long-term coordination of west coast generating resource development and operation. This provides the greatest opportunity to decrease generation of more environmentally harmful plants which would otherwise have greater effects on air, land, and water, and to avoid construction of new generation plants.

21671 (NEI-DK–1516) **Energy in the east: Possibilities for Danish supply of electricity.** Hemmingsen, J.; Frimodt, K. (eds.). Danske Elvaerkers Forening, Copenhagen (Denmark). Oct 1993. 64p. (In Danish). Order Number DE94771117. Source: OSTI; NTIS; INIS.

The document contains a number of short articles produced in relation to a meeting of leading members of the Danish electric power industry on the potentials of Danish electricity supply to Eastern Europe and the Russian Federation. A general introduction to problems arising in connection with energy supply to these areas is given. A number of short surveys present relevant statistics (on, for example, population, ethnic groups, economy, trade, language, main sectors, capital city, name of Prime Minister etc.) - and general information on each Baltic and Eastern European country and on each republic of the Russian Federation. Short articles on themes such as readjustment processes after the breakdown of communism, other political aspects, economics, consultancy and training, the European Energy Charter, a presentation of actors and contacts, and potentials that may or may not open up for Denmark in the new political situation are presented. Very brief descriptions of the management processes of some projects, already initiated, which involve the use of Danish consultancy on subjects related to the electric power industry, international cooperation within this field etc. are also given. It is hoped that the contents of these document will provide a basis for debate. (AB) (19 refs.)

25 ENERGY STORAGE

2506 Thermal

Refer also to citation(s) 21259

2508 Chemical

Refer also to citation(s) 22099

2509 Batteries

Refer also to citation(s) 21889, 22046

21672 (ANL/CHM/CP–82023) **Novel forms of carbon as potential anodes for lithium batteries.** Winans, R.E.; Carrado, K.A. Argonne National Lab., IL (United States). Chemistry Div. [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940568–3: 7. international meeting on lithium batteries, Cambridge, MA (United States), 15-20 May 1994). Order Number DE94013444. Source: OSTI; NTIS; GPO Dep.

The objective of this study is to design and synthesize novel carbons as potential electrode materials for lithium rechargeable batteries. A synthetic approach which utilizes inorganic templates is described and initial characterization results are discussed. The templates also act as a catalyst enabling carbon formation at low temperatures. This synthetic approach should make it easier to control the surface and bulk characteristics of these carbons.

21673 (SAND–93-2784C) **Self-discharge rate of lithium thionyl-chloride cells.** Cieslak, W.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940670–3: 36. power sources conference, Cherry Hill, NJ (United States), 6-9 Jun 1994). Order Number DE94011934. Source: OSTI; NTIS; GPO Dep.

Our low-rate lithium/thionyl-chloride "D" cell is required to provide power continuously for up to 10 years. The cell was designed at Sandia National Laboratories and manufactured at Eagle-Picher Industries, Joplin, Missouri. We have conducted accelerated aging studies at elevated temperatures to predict long-term performance of cells fabricated in 1992. Cells using 1.0M $LiAlCl_4$ electrolyte follow Arrhenius kinetics with an activation energy of 14.6 Kcal/mol. This results in an annual capacity loss to self-discharge of 0.13 Ah at 25 C. Cells using a 1.0M $LiAlCl_4 \bullet SO_2$ electrolyte do not follow Arrhenius behavior. The performance of aged cells from an earlier fabrication lot is variable.

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 21067, 23334

21674 (KTM/E-B–177) **Energy plan of Karelia.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 72p. Order Number DE94771064. Source: OSTI; NTIS.

Commissioned by Finnish Energy Conservation Group.

The Energy Plan for the Republic of Karelia has been prepared in collaboration between Karelian, Russian and Finnish organisations. The Finnish part of the work has been performed by the Finnish Energy Conservation Group formed by the companies Jaakko Poeyry Oy and Imatran Voima Oy. The plan deals with the development of the Karelian economy, society and energy sector up to the year 2015. The prognoses of the development are based on three scenarios: the High Growth, Medium Growth and the Low Growth Scenario with relevant variables of economic growth, energy price development, availability of energy as well as international financing possibilities of the energy projects. The electricity

consumption is expected to increase by 50 - 80 % from the 1990 level of 8 809 GWh/a by the year 2015 in the High and Medium Growth Scenarios. The primary energy consumption would accordingly increase by 23 - 53 % from the 1990 level of 4.1 Mtoe/a corresponding to 46 100 GWh/a. In the Low Growth Scenario the electricity and primary energy consumption would slightly decrease. The Republic of Karelia receives about half of its electricity from neighbouring regions and all fossil fuels from other parts of the Russian Federation. Due to the expected changes in the Russian economy which will profoundly affect its energy system, the future availability of electricity, coal and oil to Karelia at affordable prices is expected to diminish. This would cause a major shift towards the utilisation of natural gas and indigenous energy resources both in power generation and in replacing other forms of energy.

21675 (NEI-FI-228) **Council of State report to Parliament on energy policy autumn 1993.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 22p. Order Number DE94771084. Source: OSTI; NTIS.

Also published in Finnish.

The target of the Government's report to Parliament on energy policy is that the socio-economic development of society can be safeguarded and environmental hazards can be minimized. The report assumes, that the economy should resume a clearly rising trend over the next few years, and grow at an annual average rate of some 2.5 % on the long term. The report on energy policy estimates that the need for additional electrical capacity would be approximately 2000 MW in the year 2000. About 1200 MW could be suppliable through combined heat and power generation in cities and within manufacturing utilizing indigenous energy sources. As a rule, the projects would be funded on commercial terms, without any significant public aid. The remainder, i.e. 800 MW, in the year 2000 would have to be supplied by using so called base-load power. After the rejection of nuclear power made in the Parliament, there are in practice three alternatives: natural gas, coal, and import of electricity for base-load capacity. Among these alternatives, the Government clearly stresses the increased use of natural gas. Utilizing various means, the Government will encourage negotiations on the creation of a second acquisition source for gas; the objective of the Government's actions is to avoid the building of coal-fired power plants for base load power. The Government's actions focus on five main areas, which all promote the basic targets of energy policy. The actions relate to environment-based energy taxation, promotion of energy conservation, advancement of energy technology, increased use of bioenergy, and development of the energy market.

2901 Energy Analysis and Modeling

21676 (ANL/EAIS/PP-76274) **The stability of input structures in a supply-driven input-output model: A regional analysis.** Allison, T. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1994]. 27p. Sponsored by Environmental Protection Agency, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013427. Source: OSTI; NTIS; GPO Dep.

Disruptions in the supply of strategic resources or other crucial factor inputs often present significant problems for planners and policymakers. The problem may be particularly significant at the regional level where higher levels of product specialization mean supply restrictions are more likely to affect leading regional industries. To maintain economic stability in the event of a supply restriction, regional planners may therefore need to evaluate the importance of market versus non-market systems for allocating the remaining supply of the disrupted resource to the region's leading consuming industries. This paper reports on research that has attempted to show that large short term changes on the supply side do not lead to substantial changes in input coefficients and do not therefore mean the abandonment of the concept of the production function as has been suggested (Oosterhaven, 1988). The supply-driven model was tested for six sectors of the economy of Washington State and found to yield new input coefficients whose values were in most cases close approximations of their original values, even with substantial changes in supply. Average coefficient changes from a 50% output reduction in these six sectors were in the vast majority of cases (297 from a total of 315) less than +2.0% of their original values, excluding coefficient changes for the restricted input. Given these small changes, the most important issue for the validity of the supply-driven input-output model may therefore be the empirical question of the extent to which these coefficient changes are acceptable as being within the limits of approximation.

21677 (DOE/EIA-M066) **Model documentation report: Commercial Sector Demand Module of the National Energy Modelling System.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 4 Apr 1994. 209p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009597. Source: OSTI; NTIS; GPO Dep.

This report documents the objectives, analytical approach and development of the National Energy Modeling System (NEMS) Commercial Sector Demand Module. The report catalogues and describes the model assumptions, computational methodology, parameter estimation techniques, model source code, and forecast results generated through the synthesis and scenario development based on these components. This document serves three purposes. First, it is a reference document providing a detailed description for model analysts, users, and the public. Second, this report meets the legal requirement of the Energy Information Administration (EIA) to provide adequate documentation in support of its statistical and forecast reports (Public Law 93-275, section 57(b)(1)). Third, it facilitates continuity in model development by providing documentation from which energy analysts can undertake model enhancements, data updates, and parameter refinements as future projects.

21678 (DOE/EIA-M067) **Model documentation report: Residential Sector Demand Module of the National Energy Modelling System.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 4 Apr 1994. 205p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009598. Source: OSTI; NTIS; GPO Dep.

This report documents the objectives, analytical approach, and development of the National Energy Modeling System (NEMS) Residential Sector Demand Module. The report catalogues and describes the model assumptions, computational methodology, parameter estimation techniques and FORTRAN source code. This document serves three purposes. First, it is a reference document providing a detailed description for energy analysts, other users, and the public. Second, this report meets the legal requirement of the Energy Information Administration (EIA) to provide adequate documentation in support of its statistical and forecast reports according to Public Law 93-275, section 57(b)(1). Third, it facilitates continuity in model development by providing documentation from which energy analysts can undertake model enhancements, data updates, and parameter refinements.

21679 (DOE/EIA-M068-A/1) **Model documentation: Electricity Market Module, Load and Demand-Side Management submodule: Volume 1, Model description.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 7 Apr 1994. 123p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009599. Source: OSTI; NTIS; GPO Dep.

This report documents a submodule of the National Energy Modeling System (NEMS), a computer modeling system developed by the Energy Information Administration (EIA). The NEMS produces integrated forecasts for energy markets in the United States by achieving a general equilibrium solution for energy supply and demand. This report documents the LDSM submodule of the EMM. The LDSM works in conjunction with the NEMS demand modules and the other EMM submodules. This report is intended as a reference document for the LDSM, for model analysts, users, and the public.

21680 (DOE/EIA-M068-A/2) **Model documentation: Electricity Market Module, Load and Demand-Side Management submodule: Volume 2, Model code listing.** USDOE Energy Information Administration, Washington, DC (United States). Office of

Integrated Analysis and Forecasting. 7 Apr 1994. 97p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009600. Source: OSTI; NTIS; GPO Dep.

Volume II of the documentation contains the actual source code of the LDSM submodule, and the cross reference table of its variables. The code is divided into two parts. The first part contains the main part of the source code. The second part lists the INCLUDE files referenced inside the main part of the code.

21681 (DOE/EIA–M068-B) **Model documentation: Electricity Market Module, Electricity Capacity Planning submodule.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 7 Apr 1994. 177p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009601. Source: OSTI; NTIS; GPO Dep.

The National Energy Modeling System (NEMS) is a computer modeling system developed by the Energy Information Administration (EIA). The NEMS produces integrated forecasts for energy markets in the United States by achieving a general equilibrium solution for energy supply and demand. Currently, for each year during the period from 1990 through 2010, the NEMS describes energy supply, conversion, consumption, and pricing. The Electricity Market Module (EMM) is the electricity supply component of the National Energy Modeling System (NEMS). The supply of electricity is a conversion activity since electricity is produced from other energy sources (e.g., fossil, nuclear, and renewable). The EMM represents the generation, transmission, and pricing of electricity. The EMM consists of four main submodules: Electricity Capacity Planning (ECP), Electricity Fuel Dispatching (EFD), Electricity Finance and Pricing (EFP), and Load and Demand-Side Management (LDSM). The ECP evaluates changes in the mix of generating capacity that are necessary to meet future demands for electricity and comply with environmental regulations. The EFD represents dispatching (i.e., operating) decisions and determines how to allocate available capacity to meet the current demand for electricity. Using investment expenditures from the ECP and operating costs from the EFD, the EFP calculates the price of electricity, accounting for state-level regulations involving the allocation of costs. The LDSM translates annual demands for electricity into distributions that describe hourly, seasonal, and time-of-day variations. These distributions are used by the EFD and the ECP to determine the quantity and types of generating capacity that are required to insure reliable and economical supplies of electricity. The EMM also represents nonutility suppliers and interregional and international transmission and trade. These activities are included in the EFD and the ECP.

21682 (DOE/EIA–M068-C) **Model documentation: Electricity market module, electricity finance and pricing submodule.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 7 Apr 1994. 97p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009602. Source: OSTI; NTIS; GPO Dep.

The purpose of this report is to define the objectives of the model, describe its basic approach, and provide detail on how it works. The EFP is a regulatory accounting model that projects electricity prices. The model first solves for revenue requirements by building up a rate base, calculating a return on rate base, and adding the allowed expenses. Average revenues (prices) are calculated based on assumptions regarding regulator lag and customer cost allocation methods. The model then solves for the internal cash flow and analyzes the need for external financing to meet necessary capital expenditures. Finally, the EFP builds up the financial statements. The EFP is used in conjunction with the National Energy Modeling System (NEMS). Inputs to the EFP include the forecast generating capacity expansion plans, operating costs, regulator environment, and financial data. The outputs include forecasts of income statements, balance sheets, revenue requirements, and electricity prices.

21683 (DOE/EIA–M068-D) **Model documentation: Electricity Market Module, Electricity Fuel Dispatch Submodule.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 8 Apr 1994. 170p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009789. Source: OSTI; NTIS; GPO Dep.

This report documents the objectives, analytical approach and development of the National Energy Modeling System Electricity Fuel Dispatch Submodule (EFD), a submodule of the Electricity Market Module (EMM). The report catalogues and describes the model assumptions, computational methodology, parameter estimation techniques, model source code, and forecast results generated through the synthesis and scenario development based on these components.

21684 (DOE/EIA–M071) **NEMS International Energy Module, model documentation report: World Oil Market, Petroleum Products Supply and Oxygenates Supply components.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 4 Apr 1994. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009887. Source: OSTI; NTIS; GPO Dep.

The Energy Information Administration (EIA) is developing the National Energy Modeling System (NEMS) to enhance its energy forecasting capabilities and to provide the Department of Energy with a comprehensive framework for analyzing alternative energy' futures. NEMS is designed with a multi-level modular structure that represents specific energy supply activities, conversion processes, and demand sectors as a series of self-contained units which are linked by an integrating mechanism. The NEMS International Energy Module (IEM) computes world oil prices and the resulting patterns of international trade in crude oil and refined products. This report is a reference document for energy analysts, model users, and the public that is intended to meet EIA's legal obligation to provide adequate documentation for all statistical and forecast reports (Public Law 93-275, section 57(b)(1). Its purpose is to describe the structure of the IEM. Actual operation of the model is not discussed here. The report contains four sections summarizing the overall structure of the IEM and its interface with other NEMS modules, mathematical specifications of behavioral relationships, and data sources and estimation methods. Following a general description of the function and rationale of its key components, system and equation level information sufficient to permit independent evaluation of the model's technical details is presented.

2902 Economics and Sociology

Refer also to citation(s) 20899, 20916, 21060, 21698, 21706, 21726

21685 (ANL/EA/CP–82100) **Analysis of environmental regulatory proposals: Its your chance to influence policy.** Veil, J.A. Argonne National Lab., Washington, DC (United States). 2 Mar 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940374–2: Environmental issues and solutions in exploration, production, and refining, Houston, TX (United States), 2-4 Mar 1994). Order Number DE94007692. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the regulatory development process, the US Envirorunental Protection Agency (EPA) collects data, makes various assumptions about the data, and analyzes the data. Although EPA acts in good faith, the agency cannot always be aware of all relevant data, make only appropriate assumptions, and use applicable analytical methods. Regulated industries must carefully must carefully review every component of the regulatory decision-making process to identify misunderstandings and errors and to supply additional data that is relevant to the regulatory action. This paper examines three examples of how EPA's data, assumptions, and analytical methods have been critiqued. The first two examples involve EPA's cost-effectiveness (CE) analyses prepared for the offshore oil and gas effluent limitations guidelines and as part of EPA Region 6's general permit for coastal waters of Texas and Louisiana. A CE analysis regulations to the incremental amount of pollutants that would be removed by the recommended treatment processes. The third example, although not involving a CE analysis, demonstrates how the use of non-representative data can influence the outcome of an analysis.

21686 (CONF-940650–4) **Predicting social impacts associated with roadway development in a scenic area.** Schweitzer, M. (Oak Ridge National Lab., TN (United States)); Schexnayder, S.M. Oak Ridge National Lab., TN (United States). 12 Jun 1994.

17p. Sponsored by Forest Service, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual conference and exposition of the National Association of Environmental Professionals: global strategies for environmental issues; New Orleans, LA (United States); 12-15 Jun 1994. Order Number DE94013625. Source: OSTI; NTIS; GPO Dep.

The issue of predicting social impacts that could result from the construction and use of new roadways is one that faces, or will face, many communities in the U.S. and throughout the world. Where road development takes place in a scenic area, especially one that is dependent on tourist trade, the nature of the secondary land conversion that often accompanies road construction is especially important. We have assessed the social impacts likely to accompany construction of a scenic parkway in a rural area abutting the Great Smoky Mountains National Park. In this paper, we share the substantive findings of that study as well as our methodological observations on the challenges of projecting impacts in an area that has no planning or zoning, a situation that is common to many rural areas. We also discuss how we dealt with the fact that the major effects of the project would not begin until nearly 15 years in the future, when construction is completed and the roadway is opened to traffic. In order to predict land use patterns at the completion of roadway construction, we studied plat maps, which accurately reflect changing ownership patterns before such changes become apparent on the ground. We also conducted interviews with local realtors and developers who, in the absence of a local government planning department, tend to be the best sources of information concerning local land use trends. Uncertainty of future events was accounted for by projecting impacts for different scenarios, reflecting varying rates of growth and types of development. We believe that the description of our methodological approach should prove helpful to other analysts faced with the need to predict long-term transformations without the benefit of existing land use plans. In our assessment, we examined potential effects to local population, housing, land use, public services, taxes, economic structure, cultural resources, and social structure. Our findings are discussed briefly in this paper.

21687 (DOE/EA–0921) **Ambulatory Research and Education Center Oregon Health Science University: Environmental Assesment.** USDOE Chicago Operations Office, Argonne, IL (United States). Programs and Facilities Management Div. 21 Mar 1994. 28p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94010402. Source: OSTI; NTIS; GPO Dep.

DOE has prepared an Environmental Assessment (EA) (DOE/EA-0921) evaluating the proposed construction and operation of the Ambulatory Research and Education Center (AREC), which would be located on the top seven floors of the existing NeuroSensory Research Center (NRC) on the campus of the Oregon Health Sciences University (OHSU) at Portland, Oregon. The proposed action would combine activities scattered across the campus into a central facility. Based on the analysis in the EA, DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA) of 1969, 42 USC 4321 et seq. Therefore, an environmental impact statement (EIS) is not required and the Department is issuing this Finding of No Significant Impact (FONSI).

21688 (DOE/EIA–0466(92)) **Profiles of foreign direct investment in US energy, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 16 May 1994. 39p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013711. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The report reviews the patterns of foreign ownership interest in US energy enterprises, exclusive of portfolio investment (<10% ownership of a US enterprise). It profiles the involvement of foreign-affiliated US companies in the following areas: domestic petroleum production (including natural gas), reserve holdings, refining and marketing activities, coal production, and uranium exploration and development.

21689 (DOE/EIA-M–061) **Documentation of the DRI Model of the US economy, December 1993.** USDOE Energy Information Administration, Washington, DC (United States). 28 Feb 1994. 64p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008081. Source: OSTI; NTIS; GPO Dep.

The Energy Information Administration (EIA) uses models of the US economy developed by Data Resources, Inc. (DRI) for conducting policy analyses, preparing forecasts for the Annual Energy Outlook, the Short-Term Energy Outlook, and related analyses in conjunction with EIA's National Energy Modeling System (NEMS) and its other energy market models. Both the DRI Model of the US Economy and the DRI Personal Computer Input-Output Model ($PC\text{-}IO)^2$ were developed and are maintained by DRI as proprietary models. This report provides documentation, as required by EIA standards for the use of proprietary models; describes the theoretical basis, structure and functions of both DRI models; and contains brief descriptions of the models and their equations. Appendix A describes how the two large-scale models documented here are used to support the macroeconomic and interindustry modeling associated with the National Energy Modeling System. Appendix B is an article by Stephen McNees of the Federal Reserve Bank of Boston on "How Large are Economic Forecast Errors." This article assesses the forecast accuracy of a number of economic forecasting models (groups) and is attached as an independent assessment of the forecast accuracy of the DRI Model of the US Economy.

21690 (DOE/EIA–M065) **Model documentation report: Macroeconomic Activity Module (MAM) of the National Energy Modeling System.** USDOE Energy Information Administration, Washington, DC (United States). Office of Integrated Analysis and Forecasting. 7 Feb 1994. 123p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009487. Source: OSTI; NTIS; GPO Dep.

This report documents the objectives, analytical approach, and development of the National Energy Modeling System (NEMS) Macroeconomic Activity Module (MAM) used to develop the Annual Energy Outlook for 1994 (AEO94). The report catalogues and describes the module assumptions, computations, methodology, parameter estimation techniques, and mainframe source code. This document serves three purposes. First, it is a reference document providing a detailed description of the NEMS MAM used for the AEO 1994 production runs for model analysts, users, and the public. Second, this report meets the legal requirement of the Energy Information Administration (EIA) to provide adequate documentation in support of its models (Public Law 94-385, section 57.b.2). Third, it facilitates continuity in model development by providing documentation from which energy analysts can undertake model enhancements, data updates, and parameter refinements as future projects.

21691 (DOE/MI/10270–T2) **Establishing the SECME model in the District of Columbia: Quarterly report, 1 January 1994–31 March 1994.** Vikers, R.G. Georgia Inst. of Tech., Atlanta, GA (United States). [1994]. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-93MI10270. Order Number DE94011584. Source: OSTI; NTIS; GPO Dep.

During this quarter, many program activities were held to help SECME teachers and counselors implement, improve and strengthen SECME school programs in the District of Columbia. Teachers were actively engaged in enhanced instructional techniques, ideas, processes and resources to help them enrich their students' learning experience. Students are busily participating in hands-on instructional activities and preparing for the SECME competition where they are learning to excel in a competitive environment designed to help them make the most of their school experience.

21692 (LBL-PUB–3274-Rev.) **Affirmative Action Plans, January 1, 1994–December 31, 1994: Revision.** Lawrence Berkeley Lab., CA (United States). 16 Feb 1994. 294p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94011362. Source: OSTI; NTIS; GPO Dep.

This document is the Affirmative Action Plan for January 1, 1994 through December 31, 1994 for the Lawrence Berkeley Laboratory, University of California ("LBL" or "the Laboratory.") This is an official document that will be presented upon request to the Office of Federal Contract Compliance Programs, US Department of Labor. The plan is prepared in accordance with the Executive Order

11246 and 41 CFR Section 60-1 et seq. covering equal employment opportunity and will be updated during the year, if appropriate. Analyses included in this volume as required by government regulations are based on statistical comparisons. All statistical comparisons involve the use of geographic areas and various sources of statistics. The geographic areas and sources of statistics used here are in compliance with the government regulations, as interpreted. The use of any geographic area or statistic does not indicate agreement that the geographic area is the most appropriate or that the statistic is the most relevant. The use of such geographic areas and statistics is intended to have no significance outside the context of this Affirmative Action Plan, although, of course, such statistics and geographic areas will be used in good faith with respect to this Affirmative Action Plan.

21693 (NEI-DK–1525) **Resource area environment/energy: An analysis of business economics.** Miljoe/Energi, 6, Miljoe/Energi, 6. Industriministeriet, Copenhagen (Denmark). Erhvervsfremme Styrelsen. Apr 1994. 196p. (In Danish). Order Number DE94771122. Source: OSTI; NTIS; INIS.

The document comprises a detailed analysis of the business economics of resources related to energy and the environment. Non-domestic and domestic conditions influencing the business economics of this subject area, its infrastructure, problems and future perspectives are dealt with. Tables (amongst other forms of information) indicate the turnover, exports, and numbers of involved employees, workplaces and firms involved in supply, general production, consultancy and production connected with the building sector. The energy sector is the most significant in this respect, giving 30,000 employed (18% in state institutions), a turnover of 63 billion Danish kroner, and with an export of 16 billion Danish kroner. The environmental sector employs 15,000 (29% in the public sector), the total turnover is 20 billion Danish kroner and of this 3 billion Danish kroner is related to export. Many firms are relatively small. A number of firms could compete internationally and this number is growing. (AB) (79 refs.)

2903 Environment, Health, and Safety

Refer also to citation(s) 20880, 20881, 20882, 20884, 21050, 21055, 21060, 21073, 21076, 21273, 21685, 21692, 21722, 22074, 22487, 22488, 22555, 23261

21694 (CONF-940386–4) **Decision analysis applications and the CERCLA process.** Purucker, S.T. (Oak Ridge National Lab., TN (United States). Risk Analysis Section); Lyon, B.F. Oak Ridge National Lab., TN (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Cost efficient acquisition and utilization of data in the management of hazardous waste sites; Herndon, VA (United States); 23-25 Mar 1994. Order Number DE94013253. Source: OSTI; NTIS; GPO Dep.

Quantitative decision methods can be developed during environmental restoration projects that incorporate stakeholder input and can complement current efforts that are undertaken for data collection and alternatives evaluation during the CERCLA process. These decision-making tools can supplement current EPA guidance as well as focus on problems that arise as attempts are made to make informed decisions regarding remedial alternative selection. In examining the use of such applications, the authors discuss the use of decision analysis tools and their impact on collecting data and making environmental decisions from a risk-based perspective. They will look at the construction of objective functions for quantifying different risk-based perspective. They will look at the construction of objective functions for quantifying different risk-based decision rules that incorporate stakeholder concerns. This represents a quantitative method for implementing the Data Quality Objective (DQO) process. These objective functions can be expressed using a variety of indices to analyze problems that currently arise in the environmental field. Examples include cost, magnitude of risk, efficiency, and probability of success or failure. Based on such defined objective functions, a project can evaluate the impact of different risk and decision selection strategies on data worth and alternative selection.

21695 (CONF-940632–19) **Information management for global environmental change, including the Carbon Dioxide Information Analysis Center.** Stoss, F.W. (Oak Ridge National Lab., TN (United States). Carbon Dioxide Information Analysis Center). Oak Ridge National Lab., TN (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual meeting and exhibition of the Air and Waste Management Association; Cincinnati, OH (United States); 19-24 Jun 1994. Order Number DE94013279. Source: OSTI; NTIS; GPO Dep.

The issue of global change is international in scope. A body of international organizations oversees the worldwide coordination of research and policy initiatives. In the US the National Science and Technology Council (NSTC) was established in November of 1993 to provide coordination of science, space, and technology policies throughout the federal government. NSTC is organized into nine proposed committees. The Committee on Environmental and Natural Resources (CERN) oversees the US Department of Energy's Global Change Research Program (USGCRP). As part of the USGCRP, the US Department of Energy's Global Change Research Program aims to improve the understanding of Earth systems and to strengthen the scientific basis for the evaluation of policy and government action in response to potential global environmental changes. This paper examines the information and data management roles of several international and national programs, including Oak Ridge National Laboratory's (ORNL's) global change information programs. An emphasis will be placed on the Carbon Dioxide Information Analysis Center (CDIAC), which also serves as the World Data Center-A for Atmospheric Trace Gases.

21696 (DOE/EH–231-044/0394) **RCRA corrective action definitions under Subpart F and proposed Subpart S: RCRA Information Brief.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Guidance. Mar 1994. 4p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012047. Source: OSTI; NTIS; GPO Dep.

If EPA or the authorized State determines there has been a release of a hazardous waste or hazardous waste constituent at an interim status facility, RCRA Section 3008(h)(1) authorizes EPA or the authorized State to issue an administrative order requiring corrective action or other measures. There are no regulations specifically addressing corrective action orders under Subpart F. However, while an interim status facility is seeking a RCRA permit, the facility is required by 40 CFR 265 Subpart F to monitor ground water and report the results of this monitoring program to the regulatory agency. If a release of a hazardous waste or hazardous waste constituent occurs, the facility may be issued a RCRA Section 3008(h) Order to conduct corrective action. While the proposed Subpart S regulations apply specifically to SWMUs at permitted TSDFs, EPA intends to use similar corrective action requirements at interim status facilities where there has been a release of a hazardous waste or hazardous waste constituent. The specific requirements for corrective action at an interim status facility will be specified in a RCRA Section 3008(h) Order. Alternatively, EPA may compel corrective action under proposed Subpart S through a permit Schedule of Compliance, especially if the permit is expected to be issued in the near term. This information Brief discusses the terminology used in the two corrective action programs and discusses both the proposed Subpart S rule and the final CAMU and TU rule.

21697 (DOE/EH–0362) **Environmental audit of the Savannah River Ecology Laboratory (SREL).** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Audit. Sep 1993. 188p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008163. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the results of the environmental audit conducted at the Savannah River Ecology Laboratory (SREL) at the Savannah River Site (SRS), principally in Aiken and Barnwell Counties, South Carolina. The audit was conducted by the US Department of Energy's (DOE's), Office of Environmental Audit (EH-24), beginning September 13, 1993, and ending September 23, 1993. The scope of the audit at SREL was comprehensive, addressing environmental activities in the technical areas of air;

surface water/drinking water; groundwater/soil, sediment, and biota; waste management; toxic and chemical materials; inactive Waste sites; radiation; quality assurance; and environmental management. Specifically assessed was the compliance of SREL operations and activities with Federal, state, and local regulations; DOE Orders; and best management practices.

21698 (DOE/EM–0114) **United States of America Department of Energy Environmental Management Advisory Committee Public Meeting.** USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Dec 1993. 328p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94006574. Source: OSTI; NTIS; GPO Dep.

This reports contains documentation of presentations given at the United States of America Department of Energy Environmental Management Advisory Committee Public Meeting held December 14–15, 1993 in Alexandria, Virginia.

21699 (DOE/EM–0140P) **Environmental Education and Development Division (EM-522): Annual report, Fiscal year 1993.** USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Integration and Environmental Education and Development. [1993]. 52p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008620. Source: OSTI; NTIS; GPO Dep.

The Environmental Education and Development Division (EM-522) is one of three divisions within the Office of Technology Integration and Environmental Education and Development (EM-52) in Environmental Restoration and Waste Management's (EM's) Office of Technology Development (EM-50). The primary design criterion for EM-522 education activities is directly related to meeting EM's goal of environmental compliance on an accelerated basis and cleanup of the 1989 inventory of inactive sites and facilities by the year 2019. Therefore, EM-522's efforts are directed specifically toward stimulating knowledge and capabilities to achieve the goals of EM while contributing to DOE's overall goal of increasing scientific, mathematical, and technical literacy and competency. This report discusses fiscal year 1993 activities.

21700 (DOE/EM–0146P) **Innovation investment area: Technology summary.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Development. Mar 1994. 320p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012997. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of Environmental Management's (EM) Office of Technology Development (OTD) Innovation Investment Area is to identify and provide development support for two types of technologies that are developed to characterize, treat and dispose of DOE waste, and to remediate contaminated sites. They are: technologies that show promise to address specific EM needs, but require proof-of-principle experimentation; and (2) already proven technologies in other fields that require critical path experimentation to demonstrate feasibility for adaptation to specific EM needs. The underlying strategy is to ensure that private industry, other Federal Agencies, universities, and DOE National Laboratories are major participants in developing and deploying new and emerging technologies. To this end, about 125 different new and emerging technologies are being developed through Innovation Investment Area's (IIA) two program elements: RDDT&E New Initiatives (RD01) and Interagency Agreements (RD02). Both of these activities are intended to foster research and development partnerships so as to introduce innovative technologies into other OTD program elements for expedited evaluation.

21701 (DOE/EM–0162P) **Quality assurance guidance for field sampling and measurement assessment plates in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). May 1994. 148p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012998. Source: OSTI; NTIS; GPO Dep.

This document is one of several guidance documents developed by the US Department of Energy (DOE) Office of Environmental Restoration and Waste Management (EM). These documents support the EM Analytical Services Program (ASP) and are based on applicable regulatory requirements and DOE Orders. They address requirements in DOE Orders by providing guidance that pertains specifically to environmental restoration and waste management sampling and analysis activities. DOE 5700.6C Quality Assurance (QA) defines policy and requirements to establish QA programs ensuring that risks and environmental impacts are minimized and that safety, reliability, and performance are maximized. This is accomplished through the application of effective management systems commensurate with the risks imposed by the facility and the project. Every organization supporting EM's environmental sampling and analysis activities must develop and document a QA program. Management of each organization is responsible for appropriate QA program implementation, assessment, and improvement. The collection of credible and cost-effective environmental data is critical to the long-term success of remedial and waste management actions performed at DOE facilities. Only well established and management supported assessment programs within each EM-support organization will enable DOE to demonstrate data quality. The purpose of this series of documents is to offer specific guidance for establishing an effective assessment program for EM's environmental sampling and analysis (ESA) activities.

21702 (DOE/RL–91-36-Rev.2) **Standard Review Plan for Environmental Restoration Program Quality Management Plans: Revision 2.** USDOE Richland Operations Office, WA (United States). Dec 1993. 158p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94005524. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy, Richland Operations Office (RL) Manual Environmental Restoration Program Quality System Requirements (QSR) for the Hanford Site, defines all quality requirements governing Hanford Environmental Restoration (ER) Program activities. The QSR requires that ER Program participants develop Quality Management Plans (QMPs) that describe how the QSR requirements will be implemented for their assigned scopes of work. This standard review plan (SRP) describes the ER program participant responsibilities for submittal of QMPs to the RL Environmental Restoration Division for review and the RL methodology for performing the reviews of participant QMPS. The SRP serves the following functions: acts as a guide in the development or revision of QMPs to assure that the content is complete and adequate; acts as a checklist to be used by the RL staff in their review of participant QMPs; acts as an index or matrix between the requirements of the QSR and implementing methodologies described in the QMPs; decreases the time and subjectivity of document reviews; and provides a formal, documented method for describing exceptions, modifications, or waivers to established ER Program quality requirements.

21703 (ECN-C–93-014) **Energy systems and CO_2 constraints: An integrated Assessment of energy technologies for reducing CO_2 emissions at least costs in the Netherlands beyond 2000.** Okken, P.A.; Ybema, J.R.; Kram, T.; Lako, P.; Gerbers, D. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Mar 1994. 115p. Project ECN 7007 and 7037. Order Number DE94774380. Source: OSTI; NTIS; Available from the library of the Netherlands Energy Research Foundation (ECN), P.O. Box 1, 1755 ZG Petten (Netherlands).

The title study is sponsored by the Netherlands Ministry of Economic Affairs, the National Research Programme on Global Air Pollution and Climate Change (NOP), and the Netherlands Agency for Energy and the Environment (NOVEM).

In order to detect cost-effective long term CO_2 reduction strategies several scenarios are calculated with drastic (up to 80%) reductions of national CO_2 emissions in 2030 and beyond. Use has been made of the energy system model MARKAL. Using detailed compilations of data characterising available and prospective energy technologies, and incorporating projections and assumptions about the costs and availability of fuels, the model configures an optimal mix of technologies to satisfy the specified useful energy demands. Techno-economic characteristics (lifetime, investment costs, availability, energy efficiency) for ca. 400 (new) energy technologies are compiled in this report. The model is used in a

national costs minimizing mode with exogenous national maximum allowable emissions ('bubble' concept), optimising the energy system for the period 2000 to 2040 simultaneously in steps of 5 years each. Few institutional and market barriers are assumed, to reflect the maximum potential of (new) energy technologies. On the other hand bounds are imposed on the speed of market penetration for new energy technologies to prevent unrealistic solutions, and there are lower bounds to ensure that older technologies will not be phased out too rapidly. The model optimises with a 5% discount rate. The following groups of energy technologies are identified as 'robust' to CO_2 constraints. These technologies are attractive in at least three out of four technological mainstreams to reduce CO_2 emissions: energy saving measures and efficient appliances; selected renewable energy technologies; heat pumps; fuel cells; electrification; and hydrogen. 44 figs., 35 tabs., 25 refs.

21704 (INIS-mf–14222) **Manual: environmental impact statement and intervention regulation.** Neumann, K. Senator fuer Stadtentwicklung und Umweltschutz, Berlin (Germany). 1992. 96p. (In German). Order Number DE94774220. Source: OSTI; NTIS (US Sales Only); INIS.

In order to be able to fulfil also legally the important tasks of environmental protection and natural preservation in the last ten years numerous legal provisions have been issued. Many of these laws require that the environmental impact of projects and constructional measures is taken into account to a higher degree. Two important instruments in this connection are the impact statement and the intervention regulation of natural preservation. Their importance and consequences for the planning and realization of projects are until now not sufficiently know. This manual is to fill this gap. This booklet shall help builder-owners and investors to realize their building projects in a way which is compatible with the environment. For architects and planners information is given in this manual about the requirements to be fulfilled in the individual planning and licensing procedures. The booklet is structured in a way that builder-owners, consultants and authorities find quickly the information needed. (orig./KW)

21705 (INIS-mf–14231) **International experts' conference 'Promotion of environmental protection at municipal level - strategies and approaches for action' in preparation of the UN conference on environment and development (UNCED): Conference report including the 'Berlin Declaration'. International programmes and strategies for the advancement of urban environmental protection.** Stapelfeldt, U. (comp.); Klassen, I. (comp.). Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany); Bundesministerium fuer Wirtschaftliche Zusammenarbeit, Bonn (Germany); Senator fuer Stadtentwicklung und Umweltschutz, Berlin (Germany); Deutsche Gesellschaft fuer Technische Zusammenarbeit GmbH (GTZ), Eschborn (Germany). Feb 1992. 183p. (In German, English). (CONF-9202208–: International experts' conference: Promotion of environmental protection at municipal level - strategies and approaches for action in preparation of the UN Conference on Environment and Development (U, Berlin (Germany), 4-6 Feb 1992). Order Number DE94774219. Source: OSTI; NTIS (US Sales Only); INIS.

This meeting took place in Berlin in February 1992 in the run-up to the Rio UNCED conference. The proceedings compile the schedule, the opening speeches and the papers contributed on different subjects by the working groups. A declaration ('Berlin Declaration') was passed to summarize some important statements and central targets: An environmentally compatible market economy is an essential prerequisite for a lasting ecologically acceptable development of the urban areas; the towns and cities are the natural allies of the corresponding environmental policies; urban development strategies must comprise all fields which are of environmental relevance; urban development and municipal pollution abatement are interdependent; there must be enough room for sufficiently autonomous decision-making and development at the local level to ensure, last but not least, an efficient municipal environmental management (orig./HP).

21706 (INIS-mf–14249) **Environment in Saxony: Report on the environmental situation in the Free State of Saxony and about aims and measures of environmental policy of the Government of Saxony.** Saechsisches Staatsministerium fuer Umwelt und Landesentwicklung, Dresden (Germany). 1992. 35p. (In German). Order Number DE94774221. Source: OSTI; NTIS (US Sales Only); INIS.

The Staatsministerium fuer Umwelt und Landesentwicklung (Ministry for the Environment and State Development) of the Free State of Saxony puts the focus of its work on pure air, clean water, healthy soils, meadows and valleys and thus on the future of the country, its population, flora and fauna. In June 1992 a report with the planned measures of the Staatsministerium fuer Umwelt und Landesentwicklung was introduced to the members of the Landtag of Saxony. It includes the environmental situation after the unification and measures which have already been introduced by the State Government. This booklet 'Umwelt in Sachsen' ('Environment in Saxony') summarizes the planned measures. (orig./DG)

21707 (NEI-DK–1523) **Energy 2000 - the followup: A responsible and far-sighted energy policy.** Energiministeriet, Copenhagen (Denmark). Nov 1993. 41p. (In Danish). Order Number DE94771116. Source: OSTI; NTIS.

The initiatives taken in accordance with the Danish government's energy and environmental policies, and the results of these initiatives to date, are described. (AB)

21708 (NUREG/CR–6204) **Questions and answers based on revised 10 CFR Part 20.** Borges, T. (Oak Ridge National Lab., TN (United States)); Stafford, R.S.; Lu, P.Y.; Carter, D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Oak Ridge National Lab., TN (United States). May 1994. 101p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12690). Source: OSTI; NTIS; INIS; GPO.

NUREG/CR-6204 is a collection of questions and answers that were originally issued in seven sets and which pertain to revised 10 CFR Part 20. The questions came from both outside and within the NRC. The answers were compiled and provided by NRC staff within the offices of Nuclear Reactor Regulation, Nuclear Material Safety and Safeguards, Nuclear Regulatory Research, the Office of State Programs, and the five regional offices. Although all of the questions and answers have been reviewed by attorneys in the NRC Office of the General Counsel, they do not constitute official legal interpretations relevant to revised 10 CFR Part 20. The questions and answers do, however, reflect NRC staff decisions and technical options on aspects of the revised 10 CFR Part 20 regulatory requirements. This NUREG is being made available to encourage communication among the public, industry, and NRC staff concerning the major revisions of the NRC's standards for protection against radiation.

21709 (SAND–92-2244) **Large scale obscuration and related climate effects open literature bibliography.** Russell, N.A.; Geitgey, J.; Behl, Y.K.; Zak, B.D. Sandia National Labs., Albuquerque, NM (United States). May 1994. 64p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012992. Source: OSTI; NTIS; INIS; GPO Dep.

Large scale obscuration and related climate effects of nuclear detonations first became a matter of concern in connection with the so-called "Nuclear Winter Controversy" in the early 1980's. Since then, the world has changed. Nevertheless, concern remains about the atmospheric effects of nuclear detonations, but the source of concern has shifted. Now it focuses less on global, and more on regional effects and their resulting impacts on the performance of electro-optical and other defense-related systems. This bibliography reflects the modified interest.

21710 (WHC-SA–2263) **A tool for designing pollution prevention into US Department of Energy facilities.** Dorsey, J.A. (Kaiser Engineers Hanford Co., Richland, WA (United States)); Raney, E.A.; Whitehead, J.K. Westinghouse Hanford Co., Richland, WA (United States). Jan 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940632–3: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94006327. Source: OSTI; NTIS; GPO Dep.

Historically, pollution prevention activities within the Department of Energy (DOE) have focused on existing process waste streams. However, the DOE estimates that 70 percent of the opportunity to reduce or eliminate pollutants is gained or lost during design. Design is considered a critical component of the DOE's operations, products and services, as evidenced by the numerous new facilities planned to support the cleanup mission of the complex. Pollution prevention during design: (a) significantly reduces the potential generation of waste and environmental releases, (b) promotes the use of energy efficient materials, (c) minimizes resource consumption, and (d) lowers life-cycle costs. Life-cycle cost considerations during design can include construction, operation, and eventual decommissioning of the facility. This paper highlights: (1) the development of the guideline, including specific examples of the guideline's content and intended use, (2) a discussion on the philosophy and content of the training module, (3) a strategy for integrating the guideline's use into the existing DOE design process, and (4) future plans for enhancing the guideline and training class while continuing to integrate pollution prevention into the DOE design process.

2904 Energy Resources

Refer also to citation(s) 21687, 21731

21711 (DOE/EIA–0578(91)) **Energy information sheets.** National Energy Information Center, Washington, DC (United States). 2 Dec 1993. 42p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008250. Source: OSTI; NTIS; GPO Dep.

The National Energy Information Center (NEIC), as part of its mission, provides energy information and referral assistance to Federal, State, and local governments, the academic community, business and industrial organizations, and the general public. Written for the general public, the EIA publication Energy Information Sheets was developed to provide information on various aspects of fuel production, prices, consumption and capability. The information contained herein pertains to energy data as of December 1991. Additional information on related subject matter can be found in other EIA publications as referenced at the end of each sheet.

21712 (LBST–11/92, pp. 350.1-350.16) **Hydrogen as energy vector. An assessment on future hydrogen markets.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

'The objectives of the study are - the analysis of first possible markets for solar hydrogen and - investigations for predicting the conditions under which an accelerated penetration of hydrogen into the energy market could take place'. (orig.)

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 20711, 21048, 21191, 21209, 21210, 21709, 21847, 21946, 22021, 23076

21713 (DOE/EIA–0249(93)) **Directory of Energy Data Collection Forms: Forms in use as of October 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Statistical Standards. 28 Dec 1993. 65p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008253. Source: OSTI; NTIS; GPO Dep.

This is the seventeenth edition of the Directory of Energy Data Collection forms, an authoritative listing of selected public use forms currently used as basic energy information gathering tools by the Department of Energy (DOE). Originally entitled EIA Data Collection forms, this directory provides an overview of DOE's energy information collection programs for decisionmakers in Government and industry.

21714 (DOE/ER/75633–T1) **Technology Transfer Demonstration Project: Progress report, December 1993–January 1994.** Rural Enterprises, Inc., Durant, OK (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER75633. Order Number DE94013169. Source: OSTI; NTIS; GPO Dep.

The Rural Enterprises Industrial Incubator program offers beginning business a stable foundation on which to build long-term profitable concerns. These incubator facilities consist of buildings for the specific purpose of starting a new manufacturing business and are designed to accommodate a variety of manufacturing firms. Incubators are located on the Kiamichi Area Vocational Technical School system (KAVTS) campuses in Durant, Atoka, Hugo, McAlester, Stigler, Poteau, Idabel, at the REI headquarters and one in Bennington, OK. These facilities range in size from 4,800 sq.ft. to 14,000 sq.ft. and have housed businesses such as machine shops, metal fabrication companies, electronic assembly and biomedical engineering firms.

21715 (K/CSD/TM–64-Rev.5) **Automated Estimating System (AES) version 6.0 - user's manual: Revision 5.** Holder, D.A.; Schwarz, R.K. (ed.). Oak Ridge National Lab., TN (United States). Jun 1994. 196p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE94013636. Source: OSTI; NTIS; GPO Dep.

This document describes Version 6.0 of the Automated Estimating System (AES), a personal computer-based software package. The AES is designed to aid in the creation, updating, and reporting of project cost estimates for the Estimating and Scheduling Engineering Department of Central Engineering Services of Martin Marietta Energy Systems, Inc. AES provides formatted input screens to guide the user through the estimate creation/update process and provides several standardized reports that allow cost to be sorted and summarized in many different formats and at several levels of aggregation.

21716 (LBL-PUB–5382) **Laboratory Directed Research and Development Program: FY 1993.** Lawrence Berkeley Lab., CA (United States). Feb 1994. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94011381. Source: OSTI; NTIS; INIS; GPO Dep.

This report is compiled from annual reports submitted by principal investigators following the close of fiscal year 1993. This report describes the projects supported and summarizes their accomplishments. The program advances the Laboratory's core competencies, foundations, scientific capability, and permits exploration of exciting new opportunities. Reports are given from the following divisions: Accelerator and Fusion Research, Chemical Sciences, Earth Sciences, Energy and Environment, Engineering, Environment – Health and Safety, Information and Computing Sciences, Life Sciences, Materials Sciences, Nuclear Science, Physics, and Structural Biology. (GHH)

21717 (LBL-PUB–5391) **Lawrence Berkeley Laboratory FY 1994 site development plan.** Lawrence Berkeley Lab., CA (United States). 15 Apr 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94011383. Source: OSTI; NTIS; GPO Dep.

This plan describes the mission, workload, site population, site and regional information, program projections and requirements, master plan, five-year construction plan, and management considerations.

21718 (UCRL–52000-94-4) **Energy & Technology Review, April 1994.** Quirk, W.J.; Canada, J.; de Vore, L.; Gleason, K.; Kirvel, R.D; McElroy, L.; Kroopnick, H. (eds.). Lawrence Livermore National Lab., CA (United States). Apr 1994. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012133. Source: OSTI; NTIS; GPO Dep.

The Lawrence Livermore National Laboratory was established in 1952 to do research on nuclear weapons and magnetic fusion energy. Since then, other major programs have been added, including technology transfer, laser science, biology and biotechnology, environmental research and remediation, arms control and nonproliferation, advanced defense technology, and applied energy

technology. These programs in turn require research in basic scientific disciplines including chemistry, and materials science, computing science and technology, engineering and physics. This review highlights two R&D 100 award winning research topics: (1) The world's fastest digitizer which captures 30 ps transient electrical events, and (2) the MACHO camera system which fully exploits the power of large format digital imagers and integrates into one package the taking and analysis of images at a prodigious rate and the storage and archiving of extensive amounts of data. (GHH)

2906 Nuclear Energy

Refer also to citation(s) 21121, 21338, 21339, 21720, 21725, 21916, 22494

21719 (INIS-mf–14213) **HMI - historical flashback.** Weiss, B. Hahn-Meitner-Institut Berlin GmbH (Germany). 1993. 37p. (In German). Order Number DE94774085. Source: OSTI; NTIS (US Sales Only); INIS.

This brochure is based on a paper read at a HMI colloquium on 14 Juni 1993. The historical information is based on a detailed historical study published in book form under the title "Industrial-scale Research in Berlin". (orig./HSCH)

2907 Transport and Storage

Refer also to citation(s) 22444

2908 Heat Utilization

Refer also to citation(s) 21196, 21216

2910 Conservation

Refer also to citation(s) 21208, 21742

21720 (DOE/EE–0017) **Supporting synergism: Enhancing Federal, State and private sector collaboration in renewable energy and energy efficiency: Second annual report of the State Energy Advisory Board, December 1993.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1993]. 24p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94010659. Source: OSTI; NTIS; GPO Dep.

The State Energy Advisory Board first convened to counsel the Secretary of Energy and the Congress on the initiation, design, implementation, and evaluation of Federal energy efficiency and renewable energy (EE/RE) programs. The Board has developed and delivered a host of recommendations which serve to integrate and foster consistency among Federal, State, local and private sector activities. In fiscal year (FY) 1993, the Board worked closely with Department leadership to provide guidance on the implementation of several National Energy Policy Act (EPACT) provisions pertaining to the enhancement of energy efficiency and renewable energy initiatives, as well as on redefining the mission of the National Laboratories. Through these and other actions – which also include promoting EE/RE technology deployment efforts – the Board ensures that the knowledge and experience of program stakeholders, especially State and local governments, community action agencies and also the off-shore territories, are incorporated into Federal activities pertaining to energy efficiency and renewable energy.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 20777, 21711, 21723, 21724, 21725, 21733, 21856

21721 (DOE/EIA–0173(92)) **Annual report to Congress 1992.** USDOE Energy Information Administration, Washington, DC (United States). 25 Mar 1993. 65p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008255. Source: OSTI; NTIS; GPO Dep.

By Congress in 1977 as an independent entity within the Department of Energy, the Energy Information Administration (EIA) is the principal and authoritative source of comprehensive energy data for the Congress, the Federal Government, the States, and the public. During 1992, EIA provided information and analysis in response to many energy-related issues and events, including Hurricane Andrew. In addition, EIA made substantial strides in a number of critical special projects, most notably development of the National Energy Modeling System, preparation of National Petroleum Council studies on petroleum refining and natural gas, and establishment of oxygenate data program mandated by the Clean Air Act Amendments of 1990. EIA also took advantage of new opportunities for international consultations and energy information exchanges. This report to Congress contains energy-related information on the following: petroleum; natural gas; integrated analysis and forecasting; electricity; coal; energy markets and end use, nuclear, statistical standards, and information services. The appendices include: data collection surveys of the Energy Information Administration; Analytic models of the Energy Information Administration; EIA publication – EIA products available on diskette; and Major laws affecting EIA, 1974-1992.

21722 (LBST–11/92, pp. 490.1-490.8) **Investigation on the possibilities for MCH-small-scale applications.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The report contains that many details of the complex energy market that a short comment on the report is almost impossible. Out of the various abbreviations, we will use HH=Households and SME=Small and Medium Enterprises, the target groups of consumers of the task. (orig.)

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 20736, 21684, 21707, 21828

21723 (SEI-EED–31) **Energy-environment scenarios for Senegal.** Lazarus, M. (Stockholm Environment Inst. Boston, MA (United States)); Diallo, S.; Sokona, Y. Stockholm Environment Inst. (Sweden). 1994. 24p. Order Number DE94771025. Source: OSTI; NTIS.

Published in cooperation with SIDA.

This paper explores the energy and environmental dimensions of proposed energy strategies for Senegal. We do so using a quantitative analytical framework, and begin to explore how useful such numerical methods can be in an African context. Based on past studies and the environmental database system, we develop a set of emission factors for use in Senegal. Finally, we address ways to integrate the often unquantifiable environmental and economics cost and benefits for environmentally informed decision making. In summary, we find that polices intended to promote the substitution of liquid petroleum gas (LPG) for charcoal in households can actually reduce greenhouse gas emissions while contributing to the improvement of more important near-term environmental problems. At the same time, the impacts of LPG substitution on increasing the oil import bill is relatively small when compared to other petroleum product usage.Improving end-use energy efficiency also shows promise, suggesting that new demand-side initiatives are needed. Overall, the integrated energy-environment scenario approach can reveal combined policy impacts that might otherwise be missed in a single project or policy approach. 13 figs, 5 tabs

2940 Fossil Fuels

Refer also to citation(s) 20770, 21683, 21687, 21720, 21730

21724 (DOE/EIA–0035(94/02)) **Monthly energy review, February 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 24 Feb 1994. 173p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94007369. Source: OSTI; NTIS; GPO; GPO Dep.

The Monthly Energy Review gives information on production, distribution, consumption, prices, imports, and exports for the following US energy sources: petroleum; petroleum products; natural gas; coal; electricity; and nuclear energy. The section on international energy contains data for world crude oil production and consumption, petroleum stocks in OECD countries, and nuclear electricity gross generation.

21725 (DOE/EIA–0035(94/03)) **Monthly energy review, March 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 29 Mar 1994. 172p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009187. Source: OSTI; NTIS; GPO; GPO Dep.

The Monthly Energy Review provides information on production, distribution, consumption, prices, imports, and exports for the following US energy sources: petroleum; petroleum products; natural gas; coal; electricity; and nuclear energy. The section on international energy contains data for world crude oil production and consumption, petroleum stocks in OECD countries, and nuclear electricity gross generation.

21726 (DOE/EIA–0173(93)) **Annual report to Congress, 1993.** USDOE Energy Information Administration, Washington, DC (United States). 31 Mar 1994. 89p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009788. Source: OSTI; NTIS; GPO Dep.

Created by Congress in 1977 as an independent entity within the Department of Energy, the Energy Information Administration (EIA) is the principal and authoritative source of comprehensive energy data for the Congress, the Federal Government, the States, and the public. With the mandate to "collect, assemble, evaluate, analyze, and disseminate data and information," EIA's mission has been defined to: maintain a comprehensive data and information program relevant to energy resources and reserves, energy production, energy demand, energy technologies, and related financial and statistical information relevant to the adequacy of energy resources to meet the Nation's demands in the near and longer term future. Develop and maintain analytical tool and collection and processing systems; provide analyses that are accurate, timely, and objective; and provide information dissemination services. This annual report summarizes EIA's activities and accomplishments in 1993.

21727 (NEI-DK–1521) **External effects in the utilisation of renewable energy.** Risoe National Lab., Roskilde (Denmark). Systems Analysis; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 1. Sep 1993. 91p. (CONF-9309379–: Seminar on external effects in the utilisation of renewable energy, Lyngby (Denmark), 16 Sep 1993). Order Number DE94771121. Source: OSTI; NTIS.

Papers presented at a seminar held at The Technical University of Denmark (Lyngby) on September 16th, 1993, concerning external effects of the utilization of renewable energy as compared to the use of traditional energy systems. The purpose of the seminar was to give an introduction to projects on externalities in Europe in order to enrich the methodology to be utilized in relation to the Danish Council for Renewable Energy's project on comparing externalities from the various energy systems based on renewable energy sources and fossil fuels. (AB)

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 21138, 21711

2960 Electric Power

Refer also to citation(s) 21665, 21666, 21668, 21670, 21678, 21679, 21680, 21681, 21682, 21720, 21723, 21724, 21725, 21733, 21734, 21806, 21856

21728 (KTM/E-B–174) **Separating the financial accounts of network and other operations: Background study for the electricity market.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 117p. (In Finnish). Project KTM-25/881/93. Order Number DE94771066. Source: OSTI; NTIS.

Commissioned by Ekono Energy Ltd.

The proposal for a new Electricity Market Act includes a requirement that the electricity network operations and the sales of electricity by local electricity boards be separated from each other and from the other operations of the electricity boards so that they form independent profit centres in bookkeeping. Ekono Energy Ltd was commissioned to study which operations should be separated, how they should be separated, and what principles and forms should be followed in making the related calculations. The report discusses four models for separating operations. The model considered to be the best separates the electricity network operations and electricity generation into two profit centres that have their own income statements and balance sheets. Electricity generation includes the combined generation of electricity and heat. Electricity procurement is then either purchasing of electricity in bulk or purchasing of electricity from the electricity board's own power plants. Thus, sales of electricity, including procurement, do not tie up much capital and an income statement without a balance sheet is sufficient for bookkeeping purposes in this model. Combined generation is the biggest cost item shared by electricity and heat; thus it also involves the highest possibility for cross-subsidy. The starting point in the report is that combined generation is owned jointly by electricity sales and district heating; in the allocation of costs, the benefits of combined generation should be divided between both of these. Other topics discussed include the selling of network operations and formation of network companies, the need to differentiate separate networks, and the renting and leasing of networks.

21729 (KTM/E-B–175) **Transparency of electricity pricing: Background study for the electricity market act.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 50p. (In Finnish). Project KTM-26/881/93. Order Number DE94771065. Source: OSTI; NTIS.

Commissioned by Ekono Energy Ltd.

The report discusses the need for transparent pricing in the transmission and retail trade of electricity. Under the proposal for a new Electricity Market Act, the transmission and distribution networks will be required to provide access to all potential users. This will enable buyers and sellers to compete in the markets for electricity. The study examined the transparency principles on which the above electricity market can operate. The report is one of the background studies conducted for the drafting of the new Electricity Market Act. The study investigated the transparency needs of technical and financial information and the effects of tariff structures on the transparency need. A proposal has been drawn up for each segment; these proposals determine the need for transparency, or the need for regulation if transparency alone is not considered sufficient for eliminating a problem. In addition, the report includes a proposal on certain follow-up meters designed to facilitate public monitoring of the operations of network companies. In addition to defining transparency needs, the study concludes that the goals of the legislative reform cannot be attained through separation and transparency alone. A successful reform requires unequivocal instructions for separation, and nondiscriminatory tariffs for the transmission of electricity. This means, among other things that the size of the electricity producer and the location and number of the supply and reception points may not involve unjust market advantages for consortia and large units at the expense of small operators (orig.).

21730 (ORNL/CON–385) **Perspectives on the future of the electric utility industry.** Tonn, B. (Oak Ridge National Lab., TN (United States)); Schaffhauser, A. Oak Ridge National Lab., TN (United States). Apr 1994. 106p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94011933. Source: OSTI; NTIS; INIS; GPO Dep.

This report offers perspectives on the future of the electric utility industry. These perspectives will be used in further research to assess the prospects for Integrated Resource Planning (IRP). The perspectives are developed first by examining economic, political and regulatory, societal, technological, and environmental trends that are (1) national and global in scope and (2) directly related to the electric utility industry. Major national and global trends include increasing global economic competition, increasing political and ethnic strife, rapidly changing technologies, and increasing worldwide concern about the environment. Major trends in the utility

industry include increasing competition in generation; changing patterns of electricity demand; increasing use of information technology to control power systems; and increasing implementation of environmental controls. Ways in which the national and global trends may directly affect the utility industry are also explored. The trends are used to construct three global and national scenarios- "business as usual," "technotopia future," and "fortress state" -and three electric utility scenarios- "frozen in headlights," "megaelectric," and "discomania." The scenarios are designed to be thought provoking descriptions of potential futures, not predictions of the future, although three key variables are identified that will have significant impacts on which future evolves-global climate change, utility technologies, and competition. While emphasis needs to be placed on understanding the electric utility scenarios, the interactions between the two sets of scenarios is also of interest.

2980 Consumption and Utilization

Refer also to citation(s) 21201, 21723, 21872

21731 (DOE/EI/22786–T2) **State of Maine, 1993–1994 heating season: October 1993–March 1994 State Heating Oil and Propane Program.** Maine State Government, Augusta, ME (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-91EI22786. Order Number DE94013154. Source: OSTI; NTIS; GPO Dep.

The State of Maine has participated in the State Heating Oil and Propane Program (SHOPP) under the same conditions, since the inception of the grant program in 1990. During the 1980s, the State of Maine in its Office of Energy Resources (OER) did conduct weekly surveys and shared the data with the US Department of Energy (DOE). At present, the Maine State Planning Office (SPO) conducts a weekly survey following the structure of the former OER survey that is hoped to be representative of the state and a biweekly SHOPP survey to help DOE characterize the region. While this report responds to the requirement of SHOPP to submit an analysis of the heating season, it makes use of localized data collected by the Maine State Planning Office. The interpretation and analysis of Maine's heating season is informally made and developed by the Energy and Economics Division with the assistance of the Administrative Services Division.

21732 (DOE/EIA–0035(94/05)) **Monthly energy review, May 1994.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 25 May 1994. 167p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012517. Source: OSTI; NTIS; GPO; GPO Dep.

Energy production during February 1994 totaled 5.3 quadrillion Btu, a 2.2% increase over February 1993. Coal production increased 9%, natural gas rose 2.5%, and petroleum decreased 3.6%; all other forms of energy production combined were down 3%. Energy consumption during the same period totaled 7.5 quadrillion Btu, 4.1% above February 1993. Natural gas consumption increased 5.8%, petroleum 5.2%, and coal 2.3%; consumption of all other energy forms combined decreased 0.7%. Net imports of energy totaled 1.4 quadrillion Btu, 16.9% above February 1993; petroleum net imports increased 10.1%, natural gas net imports were down 4.9%, and coal net exports fell 43.7%. This document is divided into: energy overview, energy consumption, petroleum, natural gas, oil and gas resource development, coal, electricity, nuclear energy, energy prices, international energy, appendices (conversion factors, etc.), and glossary.

21733 (DOE/EIA–0214(92)) **State energy data report 1992: Consumption estimates.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. May 1994. 524p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012762. Source: OSTI; NTIS; GPO Dep.

This is a report of energy consumption by state for the years 1960 to 1992. The report contains summaries of energy consumption for the US and by state, consumption by source, comparisons to other energy use reports, consumption by energy use sector, and describes the estimation methodologies used in the preparation of the report. Some years are not listed specifically although they are included in the summary of data.

21734 (NEI-SE–156) **Energy in Sweden 1993.** Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 32p. Order Number DE94771020. Source: OSTI; NTIS.

Also available from NUTEK, S-117 86 Stockholm, Sweden.

This booklet provides information on the current energy situation, developments in energy use and energy supply, energy prices and environmental effects. Energy in Sweden is intended to provide decision makers, journalists and the general public with coherent and easily available information on developments in the energy sector. It starts with a presentation of the energy situation in Sweden, followed by an overview of the international situation and concluding with a section on energy and the environment. A swedish language version of the publication exists; 'Energilaeget 1993'

21735 (NEI-SE–157) **Energy in Sweden: Facts and figures 1993.** Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1993. 14p. (In Swedish, English). Order Number DE94771019. Source: OSTI; NTIS.

Also available from NUTEK, S-117 86 Stockholm, Sweden.

'Energy in Sweden', providing an annual overall picture of energy supply and use in Sweden in an international perspective, has been published each year by NUTEK. The supplement 'Energy in Sweden; facts and figures', contains the numerical data which the diagrams and charts in 'Energy in Sweden' are based upon. The statistics for 1992 that are included in 'Energy in Sweden 1993' are preliminary, as are therefore the tables in 'Energy in Sweden; facts and figures'. As the various preliminary figures have not been reconciled, it is also possible that comparison of the tables may reveal minor differences between them. 30 tabs

21736 (SEI-EED–25) **Informal sector energy use in Tanzania: Efficiency and employment potential.** Hosier, R. (Center for Energy and the Environment, Philadelphia, PA (United States)). Stockholm Environment Inst. (Sweden). 1994. 12p. Order Number DE94771028. Source: OSTI; NTIS.

Published in cooperation with SIDA.

The informal sector in Tanzania contains a large number of small-scale business entrepreneurs filling a largely service role in the economy. The subsectors of the informal sector included in this study were food preparation, beer brewing, grain milling, carpentry, metal working and auto repairs. Over the past several years, women have entered into this subsector as part of economic survival activities. In terms of energy efficiency, the food preparation subsectors are the least efficient, while the welders and carpenters tend to be the most efficient, as the latter make use of electricity and the former utilize traditional fuels. However, the energy use of the informal sector is limited by capital limitations - informal cement and fertilizer factories simply do not exist. To a certain scale, energy efficiency follows capital intensity in the formal sector. The most capital intensive subsectors demonstrate the smallest gross energy requirements as they make greater use of modern fuels. The least capital intensive firms utilize the most energy in the form of traditional fuels. The energy-use patterns of the informal sector differ in the same way as the overall energy consumption patterns of the three cities. 6 tabs

21737 (SEI-EED–29) **Energy conservation in the urban commercial sector in Tanzania.** Luhanga, M.L. (Ministry of Water, Energy and Minerals, Dar es Salaam (Tanzania, United Republic of)); Bwakea, T. Stockholm Environment Inst. (Sweden). 1994. 11p. Order Number DE94771026. Source: OSTI; NTIS.

Published in cooperation with SIDA.

Tanzania's commercial sector uses significant quantities of electricity, charcoal, wood and petroleum products. Food preparation, lighting and air conditioning are the primary end uses in the sector, and should provide targets for energy conservation efforts. At present, the energy bills of many firms are below 10% of their total revenue. Proposed electricity tariffs designed to reflect the economic costs of electricity delivery will result in higher total energy costs, as well as greater revenues for suppliers, even accounting

for reduced consumption. This will give incentives to firms to consider energy conservation options, including investment in energy-efficient equipment, improved maintenance of existing equipment, and more efficient use of energy in their places of business. 10 figs, 6 tabs

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 21157, 21222, 21706, 21726

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 21197

3001 MHD Generators

Refer also to citation(s) 22022

21738 (ANL/ES/CP–81789) **Simulation of three-dimensional multi-phase flow characteristics in the deswirl section of the CDIF MHD power train.** Chang, S.L.; Lottes, S.A.; Petrick, M. Argonne National Lab., IL (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9406163–1: 32. symposium on engineering aspects of magnetohydrodynamics (SEAM-32), Pittsburgh, PA (United States), 27-30 Jun 1994). Order Number DE94012644. Source: OSTI; NTIS; GPO Dep.

A three-dimensional, two-phase, turbulent flow computer code was used to predict flow characteristics of seed particles and coal gas in the deswirl section of the CDIF MHD power train system. Seed material which has a great effect on the overall performance of the MHD system is injected in the deswirl against the swirling coal gas flow coming from the first stage combustor. While testing the MHD system, excessive seed material (70% more than theoretical value) was required to achieve design operating conditions. Calculations show that the swirling coal gas flow turns a 90 degree angle to minimize the swirl motion before entering a second stage combustor and many seed particles are too slow to react to the flow turning and deposit on the walls of the deswirl section. Some seed material deposited on the walls is covered by slag layer and removed from the gas flow. The reduction of seed material in the gas flow decreases MHD power generation significantly. A computational experiment was conducted and its results show that seed injection on the wall can be minimized by simply changing the seed injection and an optimum location was identified. If seed is injected from the location of choice, the seed deposition is reduced by a factor of 10 compared to the original case.

3004 Thermionic Converters

Refer also to citation(s) 21335, 21336, 21337

3005 Fuel Cells

Refer also to citation(s) 21134, 21137, 21220, 21892, 21989, 22046

21739 (LBST–11/92, pp. 340.1-340.3) **Investigation of degradation mechanisms and causal correlation of degradation effects to operation parameters.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

'Systematic investigation of PTFE-bounded Gas Diffusion Electrodes' (showed) 'that efficiency and degradation significantly depends on preactivation process of the rolled electrodes. The electrochemical reactivation of gas diffusion electrodes is a reduction step at the hydrogen electrode in the cell stack. Hydrogen is evolved a low current densities - typically 5 $mAcm^2$ - and it is supposed, that thereby oxide layers built up during passivation will be removed.' For the investigation of both initial materials and reactivated electrodes the following methodes of measurements were employed: Porosimetry (BET); Photoelectron-spectroscopy (XPS) and - energy dispersive X-ray analysis (EDX). (orig.)

21740 (NEI-DK–1529) **Final report on the EFP program DK-SOFC 1990-92.** Knudsen, P.; Bagger, C.; Mogensen, M. Risoe National Lab., Roskilde (Denmark). Materials Dept. Mar 1994. 36p. Contract ENS-1443/90-0001; Contract ENS-1443/91-0001. Order Number DE94771103. Source: OSTI; NTIS.

EFP-90; EFP-91.

A three-year solid oxide fuel cells (SOFC) development program completed in 1992 has produced 10 cm^2 cells with area-specific resistances in the range 0.25-0.40ωcm^2 at 1000 ° C. Cathode and interconnect materials were produced in the program. Sintering of electrodes, electrolyte and interconnect was done in air at 1300 ° C. Tests with small stacks yielded promising results. Electrochemical investigations have contributed to the understanding of the electrode processes and their kinetics. CeO_2 based materials have been characterized extensively, aiming at new anode materials for direct oxidation of methane. The work was carried out by a group of six research laboratories and industrial companies. It was sponsored by the Danish government's 'EFP' program for the promotion of R and D in the energy sector as well as the electric utility groups ELKRAFT and ELSAM. (au) (39 refs.)

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 21719

21741 (KTM/E-A–4) **A year of efficient energy saving: Programme on energy conservation adds momentum to saving.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 42p. Order Number DE94771072. Source: OSTI; NTIS.

Published in Finnish as the report KTM/E-A–3.

In September 1992 the Finnish Government approved the proposal for a Programme on Energy Conservation for 1992-1996. The Programme was defined by setting sector specific targets for specific energy consumptions and using the year 2005 as a target year for longer term efficiency improvement. This publication has the purpose of describing and reporting the progress made during the first year of the Programme. Measures for energy conservation in industry have been promoted trough agreements. The Ministry of Trade and Industry and important trade organisations of the industry have signed an agreement on the measures to be taken in industry for energy conservation. This agreement will be complemented with company specific agreements. For the space heating studies have been launched to tighten standards for energy consumption in buildings and to introduce consumer-specific billing. The technical condition assessment under development will be combined with energy auditing. Efforts will be made to develop indicators for specific energy consumption. Possibilities for energy conservation in households will be studied in terms of the Linkki Programme. Energy labelling will be introduced during the second half of 1994. A separate conservation programme has been prepared for the public sector. It will be implemented on the basis of conservation agreements to be signed with municipalities. Energy auditing in the service sector has been promoted through state funding. Energy conservation in transportation is connected mainly with other activities for protecting the environment for example in the work of the Ministry of Transport and Communications. Information and advice campaigns will be organised. Biofuels and more efficient engine technologies will be studied and developed.

21742 (KTM/E-C–40) **Programme on energy conservation for the public sector.** Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 18p. Order Number DE94771083. Source: OSTI; NTIS.

Also published in Finnish and in Swedish as reports KTM/E-C–38 and KTM/E-C–39.

With a view to the implementation of the Council of State Programme on Energy Conservation adopted by the Government in the autumn of 1992, the State, municipalities and joint municipal boards have collaborated to produce a 'Programme on Energy Conservation for the Public Sector'. The purpose of the new programme is to activate and support energy conservation in the public sector. The aim is to reduce average specific energy consumptions within the facilities and functions of the State, the municipalities and the joint municipal boards. The target has been set at a reduction by the year 2005 of 10 % for heating energy and 15 % for the specific consumption of energy in electrical equipment from the levels in 1990. An intermediate goal is to have the conservation measures under way in full scale by the year 1996. The implementation of the programme has been planned to start with energy conservation in public buildings. The aim is to extend the conservation efforts next to the communal management functions, to community planning, to the indirect use of energy, and to the whole of the public functions. Focus will be on existing sites, but new investments too should be carried out increasingly energy economically. Central areas of action are the deepening of the motivation for and commitment to energy conservation, setting of the targets for and efficient monitoring of the consumption, drawing up of the plans for energy conservation, energy audits, education, training and information activities.

3201 Buildings

Refer also to citation(s) 20788, 21189, 21191, 21193, 21195, 21196, 21201, 21209, 21210, 21216, 21218, 21221, 21222, 21227, 21228, 21231, 21232, 21243, 21842, 21858, 21859, 21860, 21861, 21862, 21863, 21864, 21880, 23279, 23280

21743 (ANL/ESD–21) **District heating and cooling market assessment.** Teotia, A.P.S.; Karvelas, D.E.; Daniels, E.J.; Anderson, J.L. Argonne National Lab., IL (United States). Jun 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013451. Source: OSTI; NTIS; GPO Dep.

For more than 10 years, the U.S. Department of Energy (DOE) has supported research on and development of district steam, hot-water, and chilled-water systems in the residential and commercial sectors. In 1991, DOE sponsored a research project at Argonne National Laboratory (ANL) to reestimate the national market for district heating and cooling (DHC) systems to the year 2010. ANL had previously developed a DHC market-penetration model and used it to project future market penetration. The first step in the project was to conduct a literature search to identify major data sources on historical DHC markets and any past studies on the future market potential of DHC systems. On the basis of an evaluation of the available data and methodologies for estimating market penetration of new technologies, it was concluded that ANL should develop a new econometric model for forecasting DHC markets. By using the 1989 DOE/Energy Information Administration Commercial Buildings Energy Consumption Surveys (CBECS) public-use-tape data, a model was estimated for steam, hot-water, and chilled-water demand in the buildings surveyed. The model provides estimates of building steam, hot-water, and chilled-water consumption and expenditures between now and the year 2010. The analysis shows that the total U.S. market for district steam, hot water, and chilled water could grow from 0.8 quadrillion British thermal units (quad) in 1989 to 1.0 quad by 2000 and 1.25 quad by 2010. The demand for chilled water could nearly double in the forecast period, and its share could approach one-third of the total DHC market. This model, and the results, should be of use to policymakers, researchers, and market participants involved in the planning and implementation of community-based, energy-conserving, and environmentally beneficial energy systems.

21744 (AUC-IBT-R–9328) **Airflow and temperature distribution in rooms with displacement ventilation: Full scale measurements, analytical models and computational fluid dynamics.** Jacobsen, T.V. (Aalborg Universitetscenter, Inst. for Bygningsteknik (Denmark)). Aalborg Universitetscenter (Denmark). Sep 1993. 116p. Contract ENS-1213/91-0012. Order Number DE94771150. Source: OSTI; NTIS.

EFP-91.

The thesis deals with air flow and temperature distribution in a room ventilated by the displacement principle. Emphasis is laid on the analysis of the stratified flow region in front of the inlet device. Measurements of velocity and temperature profiles are carried out in a full scale test room. It is investigated whether empirical models based on the theory for jets can be modified to apply for the dense air current traversing the floor in front of the inlet device. The semi-analytical expressions yield reasonable approximations for maximum velocities with distance from the inlet device and the vertical velocity profiles. The occurrence of two different flow domains for the air flow along the floor is discussed. Measurements imply that the flow passes from a supercritical to a subcritical state. More advanced models are described. Computational fluid dynamics is applied in terms of a numerical turbulence model. The theory of the K-ϵ model and modifications to include stratification and low-Reynolds number effects are discussed. The numerical solution procedure is addressed and difficulties associated with the numerical modelling of the low-velocity, stratified flow are dealt with. The importance of specifying proper boundary conditions is noted, especially regarding temperature boundaries and the inlet boundary. The effects of thermal radiation must be included at the surfaces. A comparative study between measurements and model results is made. Satisfactory model results are obtained provided appropriate boundary conditions are specified. The availability of measured data is of crucial importance. (AB) (68 refs.)

21745 (AUC-IBT-R–9337) **Numerical modelling of thermal environment in a displacement-ventilated room.** Indoor Environmental Technology Paper, 34, Indoor Environmental Technology Paper, 34. Jacobsen, T.V.; Nielsen, P.V. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Oct 1993. 6p. Contract ENS-1213/91-0012. (CONF-930701–8: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). Order Number DE94771149. Source: OSTI; NTIS.

EFP-91.

It is the purpose of this paper to investigate the ability of a k-ϵ turbulence model to predict air flow and comfort conditions in a displacement-ventilated room. Stratification effects, relaminarization and heat flux at walls cause difficulties when CFD (Computational Fluid Dynamics) is applied and different approaches to overcome these problems are presented. Comparative studies between ordinary versus extended turbulence models are carried out and the effect of applying different types of temperature boundary conditions is shown. The exchange of radiative energy between the surfaces of the room and the heat flux at the walls are included to complete the description. The results show promising features and it is shown how the distribution of percentage dissatisfied occupants in the room can be obtained by combining criteria of human comfort and CFD results. This offers the opportunity to point out critical ares. (au)

21746 (BNL–60317-Vol.1) **Test procedures and protocols: Their relevance to the figure of merit for thermal distribution systems: Volume 1: Informal report.** Andrews, J.W. Brookhaven National Lab., Upton, NY (United States). Sep 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013724. Source: OSTI; NTIS; GPO Dep.

A conceptual framework is developed that categorizes measurement protocols for forced-air thermal distribution systems in small buildings. This framework is based on the distinction between two generic approaches. The 'system-comparison' approach seeks to determine, via a pair of whole-house energy-use measurements, the difference in energy use between the house with the as-found duct system and the same house with no energy losses attributable to the thermal distribution system. The 'component loss-factor' approach identifies and measures the individual causes of duct losses, and then builds up a value for the net overall duct efficiency, usually with the help of computer simulation. Examples of each approach are analyzed and related to a proposed Figure of Merit for thermal distribution systems. This Figure of Merit would serve as the basis for a Standard Method of Test analogous to those already in place for furnaces, boilers, air conditioners, and heat pumps.

21747 (BNL–60317-Vol.2) **Test procedures and protocols: Their relevance to the figure of merit for thermal distribution systems: Volume 2: Appendices.** Andrews, J.W. Brookhaven National Lab., Upton, NY (United States). Sep 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013736. Source: OSTI; NTIS; GPO Dep.

A conceptual framework is developed that categorizes measurement protocols for forced-air thermal distribution systems in small buildings. This framework is based on the distinction between two generic approaches. The 'system-comparison' approach seeks to determine, via a pair of whole-house energy-use measurements, the difference in energy use between the house with the as-found duct system and the same house with no energy losses attributable to the thermal distribution system. The 'component loss-factor' approach identifies and measures the individual causes of duct losses, and then builds up a value for the net overall duct efficiency, usually with the help of computer simulation. Examples of each approach are analyzed and related to a proposed Figure of Merit for thermal distribution systems. This Figure of Merit would serve as the basis for a Standard Method of Test analogous to those already in place for furnaces, boilers, air conditioners, and heat pumps.

21748 (BNL–60476) **High-efficiency jet refrigeration: Theoretical development and preliminary test results: Informal report.** Skalafuris, A.J. Brookhaven National Lab., Upton, NY (United States). May 1994. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013735. Source: OSTI; NTIS; GPO Dep.

Theoretical and experimental research was undertaken on an advanced jet refrigeration system, with the objective of raising the coefficient of performance from the 0.2 to 0.3 range common in these systems to at least 0.5 and possibly 0.6, at which level it could find increasing application in waste heat utilization in district heating and cooling systems and also in the transportation sector. Theoretical development was carried out leading to an experimental test configuration, which was fabricated and subjected to initial testing.

21749 (CONF-931269–, pp. 133-136) **Development of latent heat storage type ondol system.** Song, H. (Chungbuk National University, (Korea, Republic of)); Ryou, Y.; Kim, Y.; Hong, C. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The latent heat storage type ondol system was outlined which was developed on the basis of a Korean traditional ondol. The ondol unit element (450×450×20 mm) was composed of the latent heat storage tubes containing PCM as heat storage medium, bioceramic layer and heating pipes, and the ondol panel was composed of the group of unit elements. In a heating process, the ondol surface temperature was 25-26°C, while in a cooling process, 21-22°C for 6.7 hours due to discharge of latent heat, resulting in thermal energy saving and comfortable environment for ondol rooms. In a heating process, the fraction of radiation heat transfer to total heat transfer was 60-70%, while 57-65% in a cooling process, and the latent heat storage type ondol system could be thus defined as radiation heating system. In the case of space heating systems, a vertical air temperature profile was unstable, while in the ondol heating (floor heating) system, the temperature profile was remarkably stable. 8 refs., 8 figs., 1 tab.

21750 (CONF-931269–, pp. 153-156) **Analysis of exothermic reactor on solar chemical heat pump system.** Takashima, T. (Electrochemical Laboratory, Tsukuba (Japan)); Tanaka, T.; Doi, T.; Fujii, T.; Aoki, H.; Horigome, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Numerical calculations have derived temperature distribution in an exothermic reactor in a chemical heat pump that raises temperature in low-temperature solar heat by utilizing chemical reactions. A reactor was used, in which acetone and hydrogen a flown in from the reactor inlet, and catalysts are filled uniformly to cause an exothermic reaction that generates 2-propanol. The reaction was analyzed by using a material balance equation and a heat balance equation. As a result, the reactor had the temperature highest at its center in the radius direction with a temperature rise of 50°C or more, and the vicinity of the reactor wall had a temperature rise of about 20°C. Longitudinal temperature rise was highest at the vicinity of the inlet, but the temperature has resulted in a fall thereafter. According to the discussion on the final invert ratio of the endothermic and exothermic reactions in a closed system of a heat pump system, it was indicated that the final invert ratio at the reactor outlet changes due to change in the inlet temperature. It was learned that the invert ratio reaches a maximum when temperatures of acetone and hydrogen flowing into the heat generating reactor are 120°C to 140°C. 2 refs., 7 figs., 1 tab.

21751 (CONF-931269–, pp. 209-212) **Study on the recent trends of office building design.: Focusing on energy performance.** Choi, Y. (Yonsei University, Seoul (Korea, Republic of)); Lee, K.; Yoon, J. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The recent trend of office building designs in Korea was surveyed from the viewpoint of an energy performance. Various data were gathered from construction drawings of 122 buildings larger than 3,000 m^2 in gross area which were built within the latest three years in Seoul. As a result, the energy performance of office buildings was mainly affected by building shape factors such as floor height, floor width/length ratio, facade type and core type, and structure systems such as envelope system, exterior finishing material, window/wall ratio and core ratio. Each factor was more or less effective to the energy performance, and the factors relating to the building envelope were, in particular, more influential than any other factors. The issues of energy consumption on buildings were mainly attributed to building's envelope structures. Light weight structure was greater by 2.04 Mcal/m^2n average heating load per year, by 1.62 Mcal/m^2 in average cooling load per year and by 3.67 Mcal/m^2 in average total building load per year than heavy weight structure. 4 refs., 6 figs., 4 tabs.

21752 (CONF-931269–, pp. 213-216) **Daylighting performance in atrium spaces.** Lee, H. (Yonsei University, Seoul (Korea, Republic of)); Yun, W.; Lee, K. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The daylighting performance in atrium spaces was studied by scale model experiment and computer simulation. The daylighting performance was measured at 9 points on a workplane under 60 different conditions in a box-type sky simulator using the 1/25 scale model of a four-sided square atrium. The illuminance and daylight factor were also simulated at 81 points on an atrium floor. As a result, the configuration of atria expressed by section aspect ratio

(SAR), fenestration (skylight size), and interior wall features such as reflection and aperture ratio had great effect on the daylighting performance. As the section aspect ratio increased by 0.5 from the initial set of 1:1, the daylight factor decreased to one-half of it, suggesting that the section aspect ratio can be used as a useful index to figure out the daylighting performance in atria. The next important factor was the skylight size, and the effect of interior wall conditions was also dependent on the section aspect ratio and skylight size. 8 refs., 11 figs., 3 tabs.

21753 (DTH-LV–94-08) **Laboratory and practical experience with a novel water-permeable vapor retarder.** Korsgaard, V.; Pedersen, C.R. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Feb 1994. 12p. Contract ENS-1213/90-0018. Order Number DE94771151. Source: OSTI; NTIS.

EFP-90.

This paper describes a novel water-permeable vapor retarder (WPVR) that can help solve some of the moisture problems that frequently occur in certain roof and wall constructions. Preliminary results are given from investigations on moisture movements in exterior wood-frame walls carried out in a climate simulator. Three different walls have been investigated: one with a polyethylene (PE) vapor retarder on the inside, one with a WPVR on one side of the insulation layer, and one with a WPVR on both sides of the insulation layer. Results are given from measurements in a small test hut of the seasonal variation of moisture content of a number of roof segments with different vapor retarders, with or without a plywood deck between the insulation and the roof membrane. The WPVR has been installed in a large number of roofs in Denmark. Results from a few case studies are given. (au)

21754 (KTM/E-B–161) **LVIS-2000 - Future building services: Final report on the energy research programme 1988-1992.** Kohonen, R. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Heating and Ventilation). Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1994. 226p. Project KTM-305/881/87. Order Number DE94771070. Source: OSTI; NTIS.

Published in Finnish as the report KTM/E-B–160.

The Research Programme on Future Building Services (LVIS-2000) is a five-year national energy research programme which was initiated by the Ministry of Trade and Industry in 1988. Its objective has been to present alternative solutions for managing the energy use and indoor climate conditions of buildings of the future. The research dealt primarily with new buildings, but an important dimension of the systems development was suitability for use in renovations. The research was directed at residential and commercial buildings. The applications of the research projects, the so-called jointly funded projects, aimed first and foremost at product development for energy and automation systems as well as the development of installation and operating technology. The research areas of the LVIS-2000 programme have been the energy systems of buildings, energy management systems in buildings as well as the indoor climate and energy. The research has led to the development of a unified systems theory for HVAC, electrical and energy management systems. A feature which all the systems development projects share in common is an implementation model that springs from functional needs as well as suitability for building construction that is based on industrialized building and a modular market model. In the studies dealing with the fundamentals of systems development, a more accurate picture has been obtained of criteria connected with ventilation and lighting requirements, thermal comfort as well as control solutions for the HVAC processes and availability performance.

21755 (KTM/E-B–162) **ETRR - Energy-efficient buildings and building components: Final report on the energy research programme 1988-1992.** Saarimaa, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Building Production); Hyttinen, R.; Immonen, K. Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 200p. (In Finnish). Project KTM-300/881/87. Order Number DE94771069. Source: OSTI; NTIS.

ETRR Research Programme.

The research programme on energy-efficient buildings and building-components (ETRR) examines construction methods by which the use of energy can be made more efficient so that the performance requirements set for buildings - such as the indoor climate conditions - will be fulfilled. In addition, the programme sets out ways in which the energy utilization by different types of buildings can be made more efficient through a combination of solutions applied to the buildings' external envelopes and building services technologies. The key results of the research programme include low-energy house concepts produced both for new buildings and for existing buildings. Solutions are presented, both for single-family houses and for apartment blocks, by which energy consumption can be reduced by 25 %, 50 %, 75 % and more than 75 % of present levels. The results have been put into practice in test building projects, which have been carried out so far in new building, especially in the form of single-family house experimental projects. The experimental building has been done in the framework of company projects in the programme. Of the ways of saving energy in the building's external envelope, windows yield the highest potential, both in new building and in renovation work. Transparent insulating materials are technically a potential way of making a structure's energy utilization more efficient. Solutions based on transparent insulating materials are mostly too expensive at present compared with the benefits attained. It is technically possible to make buildings in such a way that external, purchased energy is not required for heating them.

21756 (LBL–33887) **Buildings sector demand-side efficiency technology summaries.** Koomey, J.G. (and others); Johnson, F.X.; Schuman, J. Lawrence Berkeley Lab., CA (United States). Mar 1994. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94011005. Source: OSTI; NTIS; GPO Dep.

This report provides descriptions of the following energy efficiency technologies: energy management systems; electronic fluorescent ballasts; compact fluorescent lamps; lighting controls; room air conditioners; high albedo materials, coatings and paints; solar domestic water heaters; heat pump water heaters; energy-efficient motors; adjustable-speed drives; energy-efficient refrigerators; daylight control glazing; insulating glazing; solar control glazing; switchable glazing; tree planting; and advanced insulation. For each technology, the report provides a description of performance characteristics, consumer utility, development status, technology standards, equipment cost, installation, maintenance, conservation programs, and environmental impacts.

21757 (LBL–34675) **Zone conditioning in a California foothill house.** Jump, D.; Modera, M. Lawrence Berkeley Lab., CA (United States). Dec 1993. 47p. Sponsored by USDOE, Washington, DC (United States);California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. Order Number DE94011008. Source: OSTI; NTIS; GPO Dep.

The principal focus of the reported research is the performance of the installed zoned air distribution system in a house located in the foothills northeast of Sacramento California. The 297 m^2 two story house contained a central air conditioner and an air distribution system with four dampered supply duct legs. The air conditioning system included a two speed fan and two speed compressor, with the air handler placed inside a closet and almost all the ducts located inside the building envelope. The uninsulated sheet metal ducts ran inside a space between stories and in interior walls. The performance parameters examined included: (1) duct leakage, (2) duct conduction, (3) zoning performance and (4) equipment efficiency impacts. In conclusion, two major points were made concerning the test house. The first was that substantial energy benefits were d by placing the ducts inside the conditioned space. The second was that the energy benefits from zoning the house were not realized, primarily due to thermal stratification and the open floor plan in the house. Secondary impacts lowering zoning performance were the k& of return duct dampers and leakage and conduction losses in the air distribution system. Utility programs or building standards promoting zoning as a means of conserving energy or reducing peak power demand should be aware of the many potential pitfalls that can arise with zone conditioning, particularly with dampered air distribution systems.

21758 (LBL–35520) **DOE-2 basics version 2.1E.** Birdsall, B.E. (Lawrence Berkeley Lab., CA (United States)); Buhl, W.F.; Ellington, K.L.; Erdem, A.E.; Winkelmann, F.C.; Hirsch, J.J.; Gates,

S. Lawrence Berkeley Lab., CA (United States). May 1994. 323p. Sponsored by USDOE, Washington, DC (United States);Gas Research Inst., Chicago, IL (United States);Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC03-76SF00098. Order Number DE94013165. Source: OSTI; NTIS; GPO Dep.

DOE-2 is an up-to-date, unbiased, well-documented public-domain computer program for building energy analysis. DOE-2 predicts the hourly energy use and energy cost of a building given hourly weather information and a description of the building and its HVAC equipment and utility rate structure. DOE-2 is a portable FORTRAN program that can be used on a large variety of computers, including PC's. Using DOE-2, designers can determine the choice of building parameters that improve energy efficiency while maintaining thermal comfort. The purpose of DOE-2 is to aid in the analysis of energy usage in buildings; it is not intended to be the sole source of information relied upon for the design of buildings. The judgment and experience of the architect/engineer still remain the most important elements of building design.

21759 (NEI-DK–1541) **Gas-filling and thermal conduction in monolithic silica aerogel: A survey of relevant literature.** Engell, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Mineralindustri. [1994]. 27p. (In Danish). Contract ENS-1213/90-0007. Order Number DE94771111. Source: OSTI; NTIS.

EFP-90.

In order to find the most suitable type of gas for filling highly insulating silica-aerogel window panes, a critical survey of the content of literature dealing with the conditions which are influential for the heat conducting properties of this aerogel is presented. Based on information derived from this literature, a consistent model of the distribution of pore sizes in AIRGLASS AB aerogels as a function of their volume weight is set up. Data found on gas diffusion in these materials are given and the theory of gas-heat conduction in microporous systems where the gas molecules' mean free path is comparable with or larger than the pores' is explained. Based on this information and on published data on heat conduction in silica aerogels, it is concluded that Ar, O_2 and N_2 are the most suitable gases for filling silica aerogel window panes. The three gases live up to the requirements for environmental protection. Purchased in a cylinder for compressed gas (10 m^3), Ar costs twice as much as N_2 and O_2. The conditions of thermal conductivity $\mu Ar(micro):\mu 02(micro):\mu N_2(micro)$ for the three gases should be close to 0.6:0.9:1 under the same outer conditions (T, p, gel). (AB) (43 refs.)

21760 (NEI-FI–222-Vol.1) **Indoor Air '93. Health Effects: Proceedings.** Jaakkola, J.J.K. (Helsinki Univ. of Technology, Otaniemi (Finland)); Seppaenen, O.; Ilmarinen, R. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. 827p. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

The main topics in this volume 1 are: (1) Perceptions and sensory reactions as indicators of indoor air quality. (2) Allergic and infectious diseases due to indoor environment. (3) Indoor climate, building design and work related factors as risk factors of the sick building syndrome. (4) The health effects of combustion products. (5) The health effects of volatile organic compounds and formaldehyde. (6) The use of biological indicators and tests in indoor air quality studies. (7) Methodological issues in environmental health investigations, Odors in indoor air. (8) Indoor air as a source of allergy and hypersensitivy. (9) The health effects of environmental tobacco smoke. (10) The design of indoor air quality related studies.

21761 (NEI-FI–222-Vol.1, pp. 3-12) **Indoor air pollution: a public health perspective.** Samet, J.M. (Univ. of New Mexico (United States). Cancer Center. Dept. of Medicine and the New Mexico Tumor Registry). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

In developed and developing countries, indoor air pollution is gaining increasing prominence as a public health problem. Time-activity studies and exposure surveys have shown the dominant contributions of indoor environments to population exposures for many pollutants. Mounting epidemiologic evidence documents adverse health effects of indoor pollutants and risk assessments indicate that indoor carcinogens may contribute substantially to the population's burden of lung and other cancers. Unacceptable indoor air quality has also been identified as a common cause of symptoms. This presentation addresses the public health problem posed by indoor air pollution, offering a schema for categorizing adverse health effects of indoor air pollution, and considers the complexity of estimating the full scope of the problem.

21762 (NEI-FI–222-Vol.1, pp. 47-52) **The effect of room temperature on symptoms and perceived indoor air quality in office workers. A six week longitudinal study.** Reinikainen, L.M. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating and Ventilation); Jaakkola, J.J.K. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

The objective of this study was to evaluate the effect of room temperature on the symptoms of the sick building syndrome (SBS) and related symptoms and the perception of indoor air quality in a six week longitudinal study. The study population consisted of 109 office workers. The participants recorded daily the temperature of their office. They also kept a diary of their symptoms and perceptions of the indoor air. The relation between the average individual daily symptom scores and the average room temperature was assessed in a multiple linear regression model. There was a statistically significant linear increase in dryness symptoms, allergic symptoms, SBS symptoms and the sensation of warmth and the sensation of dryness with temperature in the range from 21.0 deg C to 25 deg C.

21763 (NEI-FI–222-Vol.1, pp. 265-271) **Changes in indoor air and human response induced by electric heating units.** Raunemaa, T. (Univ. of Kuopio, Kuopio (Finland). Lab. for Atmospheric Physics and Chemistry); Sammaljaervi, E. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

Healthy adults were exposed for 75 min to the test room air, when an electric flow-thru or encapsulated heater was in operation. Environmental parameters of relative humidity temperature, particle number and size distribution, and ozone and nitrogen oxides were continuously registered. Nose lavage histamine concentration and lung function measures were monitored for short-term exposure effects. The flow-thru unit effected a rise in submicron particles and seemed to impair lung function (PEF, FEV_1, FEF). The small number of exposures renders these results tentative.

21764 (NEI-FI–222-Vol.1, pp. 285-290) **The Helsinki office environment study: the type of ventilation system and the 'sick building syndrome'.** Jaakkola, J.J.K. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating and Ventilation); Miettinen, P.; Tuomaala, P.; Seppaenen, O. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

The objective of the present study was to assess the types of heating, ventilating and air conditioning (HVAC) systems in office buildings as determinants of the occurrence of symptoms of the 'sick building syndrome' (SBS) and perceived air quality in workers.

In the Helsinki Office Environment Study a self-administered questionnaire was directed at the occupants of 41 buildings selected randomly from all the 894 eligible buildings in the Helsinki metropolitan area. The study population included 2678 office workers who returned a filled in questionnaire (response rate 81 %). The outcomes included the occurrence of nine weekly work-related symptoms of the SBS and perceptions of thermal comfort and unpleasant odors during the past 12 months. The symptoms were slightly more common among the occupants of the buildings with simple mechanical ventilation than among the occupants of the naturally ventilated buildings. The risk of nasal symptoms, and central nervous symptoms such as lethargy and difficulties in concentrating, was significantly greater in workers in buildings with evaporative but not with steam humidification, compared to workers in both naturally and mechanically ventilated buildings without humidification. The risk of nasal congestion was significantly increased in the workers of buildings with air recirculation compared to similar buildings without air recirculation.

21765 (NEI-FI–222-Vol.1, pp. 303-307) **The office illness project in northern Sweden: A study of offices with high or low prevalences of SBS: electromagnetic fields in our indoor environment.** Sandstroem, M. (National Inst. of Occupational Health, Umeaa (Sweden). Dept. of Occupational Medicine); Berglund, A.; Mild, K.H. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

As a part of the Office Illness Project in Northern Sweden we have studied the electromagnetic environment in 22 office buildings. The aims of the study were to compare different methods of measuring and the levels of the electromagnetic fields in the offices. The measurements included power frequency magnetic and electric fields as well as measurements of air ions in the office. Offices with high as well as low prevalence of SBS were selected. The study showed no obvious difference between magnetic field spot measurements and long-term recordings as seen on the mean value for all the offices. However, for some of the offices a 5-fold difference can be seen. The long-term measurement gave us an estimate of the time variation of the field. The results of these measurements depend very much on sampling time and this is most prominent in the calculation of changes in the magnetic field with time. For some of the offices a more than 10-fold higher level of the electric field was found if the instrument was used under grounded compared to ungrounded conditions. The amount of air ions, positive as well as negative, in the offices was in general very low, a couple of hundred/cm^3. The study did not support the hypothesis that any of the measured parameters could be an explanation model for increased prevalence of SBS in buildings.

21766 (NEI-FI–222-Vol.1, pp. 435-440) **Residential exposures to nitrogen dioxide and respiratory illnesses in infants.** Lambert, W.E. (Univ. of New Mexico School of Medicine, Albuquerque, NM (United States)); Samet, J.M.; Skipper, B.J.; Cushing, A.H.; Hunt, W.C.; Young, S.A.; Schwab, M.; Spengler, J.D. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

Exposures to nitrogen dioxide (NO_2) and respiratory illnesses were monitored prospectively from birth to 18 months of age in a cohort of 1,205 infants living in homes with gas and electric cooking stoves. The sample was restricted to nonsmoking households. NO_2 exposures were estimated using passive diffusion samplers placed in the infants' bedrooms, and daily occurrences of respiratory symptoms and illnesses were recorded by the mothers. In multivariate analyses that controlled for other determinants of illness, no consistent trends in incidence or duration of illness were observed by level of NO_2 exposure at the time of illness or during the prior month, or by type of stove.

21767 (NEI-FI–222-Vol.1, pp. 441-446) **Indoor air quality and child exposures in highland Guatemala.** Smith, K.R. (East-West Center, Honolulu, HI (United States). Program on Environment); Liu, Youcheng; Johnston, C.S.; Rivera, J.; Boy, E.; Leaderer, B.; Yanagisawa, Yukio; Lee, Kiyoung. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

Sixty households using three different wood fired cook stoves and one gas stove were monitored over 24 hours for TSP, PMI0, CO, and NO_2 in the kitchen and bedroom. Simultaneous personal passive sampling for CO and NO_2 was conducted with the youngest child and his/her chief care giver. Comparisons by fuel type are given along with correlations among the different pollutant/location pairs.

21768 (NEI-FI–222-Vol.1, pp. 447-451) **Effects of indoor air pollution on respiratory illness of school children.** Qin, Y.H. (Chinese Academy of Preventive Medicine (China). Inst. of Environmental Health Monitoring); Cao, Z.J.; Zhang, X.M.; Jin, H.Z.; Liu, Y.Q.; Fans, D.L. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

This study involved schoolchildren who were 10-15 years old and were selected in 4 cities in China. Their activity patterns, exposure levels and respiratory illnesses were investigated. The 750 children we knew, spent about 80.71 % (in winter) and 74.83 % (in summer) of their time indoors. The time-weighted average exposures of respiratory particles (RP), sulfur dioxide (SO_2,) and carbon monoxide (CO) of children in households using coal stoves was much higher than those in households using gas (or LPG) stoves. The prevalence of respiratory illness of the Children in the former case was also higher than that in the latter case.

21769 (NEI-FI–222-Vol.1, pp. 483-488) **Objective effects of nitrous acid gas on eye epithelium in healthy subjects.** Kjaergaard, S. (Aarhus Univ. (Denmark). Inst. of Environmental and Occupational Medicine); Rasmussen, T.R.; Pedersen, O.F.; Brauer, M. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

The gas of nitrous acid (HONO) is produced during indoor air combustion processes and from NO_2. The hypothesis of this study was that HONO may have an effect on humans. This paper present effects measured on the eyes. 15 healthy non-smokers were exposed to 4, 77 and 395 ppb of HONO. A baseline period preceded two similar exposure sessions divided by 10 minutes of exercise. Bulbar conjunctival vasodilation was measured by comparison of standardized photographs and showed a dose dependent but insignificant change. Polymorphonuclear neutrophils, cuboidal and squamous epithelium cell counts in the tear fluid were significantly increased. There were no sensory responses in mucosal membranes. The trigeminal sensitivity of the eyes as evaluated by a CO_2 eye provocation test showed a dose related increase in the response intensity to 160 ml/l CO_2. This increased sensitivity and the ability to induce inflammatory reactions suggest that HONO may also affect asthmatics. In conclusion the study support the hypothesis that HONO is an important factor in combustion toxicology.

21770 (NEI-FI–222-Vol.1, pp. 489-492) **A study on the relation between indoor exhaust and lung cancer.** Liu, Jun-Zhuo (Beijing Medical Univ. (China). Dept. of Environmental Health); Hu, Han-Sheng; Hu, Yong-Hua; Lu, Pei; Hao, Lan-Ying. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and

Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

An epidemiological research - case-control study on risk factors for lung cancer was carried out in a county, in Northern China, where the air pollution was rather light. After statistical analysis by Conditional Logistic Regression Model Software, the results showed that indoor exhaust (using the coal stove without a chimney at home) was one of the risk factors for lung cancer. Smoking and serious psychic trauma which had been known as the risk factors for lung cancer, also displayed the same in this study. The factors which had no significant relation in this study were the area of living quarters per person and indoor illumination coefficient. The ambient air quality, the years of occupancy, kinds of occupation, house type, styles of cooking and/or heating and kinds of coal were the same both in cases and controls.

21771 (NEI-FI–222-Vol.1, pp. 493-498) **The extent of exposure and health effects of household coal burning in urban residential areas in South Africa.** Nel, C.M.E. (Medical Research Council (South Africa). National Urbanisation and Health Research Programme); Terblanche, A.P.S.; Opperman, L.; Kock, A.; Nyikos, H. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

Household coal burning is one of the major sources of total suspended particulate matter (TSP) in African urban residential areas in South Africa. The coal stoves used are usually poorly vented or unvented, consequently resulting in high levels of indoor air pollution. The effects of household fuels used in two Townships in the Vaal Triangle (central South Africa) on the health of 8-12 year old children living in these households, were investigated. Personal exposures of 45 children to TSP, resulting from mainly coal burning, determined over 12 hour periods during the summer and winter of 1991 and 1992, indicated extremely high exposures. The health questionnaire data indicated that 59.9 % of the population uses coal for space heating and cooking purposes. Most of the population perceived coal burning as the major source of air pollution in their area. The respiratory illness prevalence rates for the populations living respectively in three exposure areas: a coal burning area, a partially electrified area and an electrified area, were relative low with no statistical significantly difference in prevalence rates for the different exposure areas. However, children living in an area where only coal was burned had a respectively 170 % and 120 % higher risk of developing Upper Respiratory Tract Illnesses (URI) than children living in a partially electrified and a totally electrified area. The health data were collected during the summer period which is the period of lowest exposure to air pollution. Crowding and environmental tobacco smoking (ETS) did not have a marked effect on the risk to develop URI and LRI.

21772 (NEI-FI–222-Vol.1, pp. 499-503) **Studies on the effects of air pollution and the environmental intervention.** Xiaoming, Zhang (Hebei Provincial Anti-Epidemic Station, P.R. (China)). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.1: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Health Effects: Proceedings.* 827p. Order Number DE94771100. Source: OSTI; NTIS.

Published in 6 volumes.

The monitoring of air pollution and health levels was carried out in coal burning districts and the districts with central heating in Chengde City. The air pollution levels in winter and summer were compared in coal burning districts and the districts with central heating, indoors and outdoors, in kitchens and bedrooms, before and after the central heating system was used. The health levels of residents who lived in coal burning districts and in the districts with central heating were compared. The effects of environmental intervention of central heating were demonstrated preliminarily through the analysis of the environmental quality, the evaluation of health effects and the estimation of economic benefits. Chengde City is located in the northern part of Hebei Province, and the urban air pollution is serious. The city government has planned to develop the central heating in phases, in order to clean the air. The effects of the environmental intervention of central heating on the environment and human health will be discussed in this article by using experimental epidemiologic AI analysis of the air pollution.

21773 (NEI-FI–222-Vol.2) **Indoor Air '93. Chemicals in indoor air, material emissions: Proceedings.** Saarela, K. (Technical Research Centre of Finland, Espoo (Finland)); Kalliokoski, P.; Seppaenen, O. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. 718p. (CONF-930701–Vol.2: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). Order Number DE94771099. Source: OSTI; NTIS.

Published in 6 volumes.

The International Conference of Indoor Air Quality and Climate was held in Espoo. Finland, on July 4-8, 1993. The Conference was organized by Helsinki University of Technology, Laboratory of Heating, Ventilation and Air Conditioning. The topics of this volume are: The concentrations and variations of organic chemicals in offices, public buildings and residential buildings are presented. The effects of outdoor sources of organic gases on indoor air quality. The use of pesticides and their occurrence in indoor air. Sampling and analysis of chemicals in indoor air. Typical volatile organic compounds found in indoor air. The use of passive sampling in indoor air quality studies. Comparison of new and old sampling methods. Comparison of different building materials based on their emissions. Development of test methods. Modelling of the emission process based on chamber tests. Sensory evaluation of building materials. Indoor air quality in automobiles. Selection of materials and design criteria of healthy buildings.

21774 (NEI-FI–222-Vol.2, pp. 177-181) **Indoor air VOC pollution caused by gasoline spill.** Braathen, O.A. (Norwegian Inst. for Air Research, Lillestroem (Norway)); Schmidbauer, N. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.2: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Chemicals in indoor air, material emissions: Proceedings.* 716p. Order Number DE94771099. Source: OSTI; NTIS.

Published in 6 volumes.

Due to a gasoline spill in the Alvdal area in Norway, the concentrations of organic compounds in indoor air in six buildings were measured. The spill occurred in July 1990. In January 1992, the total concentration of the included components was as high as 53 640 $\mu g/m^3$ in the building closest to the site of the spill. The remediating steps taken and the movement of the gasoline have reduced the concentrations to the extent that in December 1992 the highest total concentration that was measured was 1675 $\mu g/m^3$.

21775 (NEI-FI–222-Vol.5) **Indoor Air '93. Ventilation: Proceedings.** Seppaenen, O. (Helsinki Univ. of Technology, Otaniemi (Finland)); Saeteri, J.; Railio, J. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. 600p. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The International Conference of Indoor Air Quality and Climate was held in Espoo. Finland, on July 4-8, 1993. The Conference was organized by Helsinki University of Technology, Laboratory of Heating, Ventilation and Air Conditioning. In this volume 100 papers are presented from the conference. The distribution of ventilation rates and air infiltration rates in offices and dwellings in different countries are shown. New sensors and their use for demand controlled ventilation are discussed. Design and design criteria for fresh air inlets in dwellings are dealt in some papers. Measurements and numerical prediction of air and contaminant distribution in rooms are shown. Numerical prediction of air flows in buildings also with multi-zone models. New solutions for individual control of workplace temperature and ventilation are presented,

same as new HVAC components and their performance. Dispersion of pollutants in multi-zone enclosures, like hospitals, and solutions for prevention of the dispersion of harmful biological contaminant in hospitals are discussed.

21776 (NEI-FI–222-Vol.5, pp. 15-20) **Evaluation of draught risk from outdoor air intakes above the window.** Heikkinen, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Heating and Ventilation); Kovanen, K.; Piira, K.; Siitonen, V. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The air movement caused by three air inlets above the window was measured. The designs were a slot diffuser, a radial ceiling diffuser and a multi nozzle radial diffuser. The test room had a triple glazed window and a convective heater below the window. The results show that it is possible to achieve acceptable thermal comfort using air flow rates up to 8 litres per second, at outdoor air temperatures of 0 deg C and -20 deg C when the draught criterion is based on a 20 percent level of dissatisfied occupants. A supply velocity of more than 2-3 m/s should be used. The curtains and their supports have an unfavourable effect on air movement and draught risk. Jet theory can be used to draw general conclusions regarding the effects of the supply air velocity and mixing properties of the diffuser.(orig.)

21777 (NEI-FI–222-Vol.5, pp. 21-26) **Increasing outdoor air flow rates in existing buildings.** Mudarri, D.H. (Environmental Protection Agency, Washington, DC (United States). Indoor Air Div.); Hall, J. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Many existing buildings were designed for relatively low rates of outdoor air ventilation (2.5 l/s/occupant or 5 cfm/occupant). Nevertheless, building owners and managers face requests by occupants and consultants to raise outdoor ventilation rates in order to satisfy demands for improved indoor air quality. This article examines the feasibility, and potential energy and IAQ impact of attempts to raise outdoor ventilation rates from 2.5 to 10 l/s/occupant (5 to 20 cfm/occupant) in existing buildings. A parametric analysis using DOE-2 simulations was used to generate both energy and indoor air quality data. Our analysis suggests that the energy impacts are minimal, but that capacity problems are sometimes encountered when ventilation rates are raised in existing buildings.

21778 (NEI-FI–222-Vol.5, pp. 45-50) **Indoor air quality and energy consumption with demand controlled ventilation in an auditorium.** Fehlmann, J.; Wanner, H.U.; Zamboni, M. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The ventilation system of an auditorium was regulated in response to continuously measured CO_2 concentrations in the room, or according to the time-table of the occupancy. The running time, the energy consumption and several climatic parameters as well as the CO_2 concentrations were measured under winter and summer conditions. Furthermore, the occupants' judgement of the indoor air quality was surveyed with a questionnaire. It was Shown that during the monitored periods the ventilation controlled by measured CO_2 concentrations consumes 80 % less energy during summer and 30 % less during winter than the Ventilation operating on a fixed time-schedule. If all the avoidable sources of odour in tile room would be eliminated, the indoor quality would still remain within an acceptable range.(orig.)

21779 (NEI-FI–222-Vol.5, pp. 51-56) **Energy saving in buildings by demand controlled ventilation system.** Haghighat, F. (Concordia Univ., Montreal, QB (Canada). Centre for Building Studies); Zmeureanu, R.; Donnini, G. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

There are two techniques to evaluate the impact of demand-controlled ventilation procedure on the energy performance of buildings: Field measurements, or computer simulation. This article, first presents the results of field measurements carried out in a commercial building in Montreal. Then, the computer model of a large office building in Montreal, which was developed using the MICRO-DOE2 pro gram, is used along with the Functional Values feature to simulate the demand-controlled ventilation systems. The use of MICRO- DOE2 for simulation is a new approach, since normally this ventilation procedure cannot be analyzed by the energy analysis pro grams. Different scenarios for this type of ventilation control are evaluated, and then the impact on the energy-efficiency of the entire building is assessed.

21780 (NEI-FI–222-Vol.5, pp. 57-62) **Future of DCV - What is economically feasible.** Helenelund, C. (Vaisala Oy, Helsinki (Finland)). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Much has been said and published on Demand Controlled Ventilation (DCV). Research and tests have shown the most common air pollutants present in buildings and the cause of their existence (human presence, emission from building materials or bad inlet air). Many methods have also been suggested on how to improve indoor air quality and/or to save energy costs. Several more or less well operating DCV systems have been introduced over the years. However, there still seems to be a major gap between scientific conclusions, presently available products and practical solutions that really can be accepted by the market. This article discusses views formed during a recent study on gas measurement based DCV, related sensing technologies and on the actual market situation. In addition to literature studies the study has included interviews and testing of commercially available products. The text points out that technological limitations and economical constraints will most probably have a greater influence on the winning concept than earlier anticipated.

21781 (NEI-FI–222-Vol.5, pp. 69-72) **Occupant use of ventilation controls and humidifiers during cold seasons.** Kelly, K. (Jay-K Independent Lumber Co. Inc., New Hartford, NY (United States)); Brien, M.; Stemp, R. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

During the past two decades the desire to save energy has created tight houses with chronic moisture problems. This situation prompted us to mail a questionnaire to 3000 Jay-K Home Center customers in December 1991 to determine heating season fresh air sources, occupants' use of air change devices, (i.e., actual ventilation), humidifier use, and humidifier cleaning. Occupants' disregard for fresh (outdoor) air and replacement air sources when exhausting air with furnaces, exhaust fans, and clothes dryers indicates that occupants are not taking steps to ensure good indoor air quality. The presence of uncleaned home humidifiers adds to the problem. Based on the data obtained, a review of building ventilation standards and humidifier use may be advisable.(orig.)

21782 (NEI-FI–222-Vol.5, pp. 73-78) **Evaluation of residential ventilation controller technology.** Kesselring, J.P. (Electric Power Research Inst., Palo Alto, CA (United States)); Koontz, M.D.; Cade, D.R.; Nagda, N.L. Helsinki Univ. of Technology,

Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

A low-cost, CO_2-based controller connected to an energy recovery ventilator (ERV) was evaluated over a 5-day period in an energy-efficient demonstration house located in Florida. Parameters monitored included temperature, humidity, air exchange rate, energy consumption, ERV on-time, and CO_2 and radon levels. CO_2 production from a four-person family was simulated to yield indoor CO_2 levels above 1,000 μL/L (ppm) in the absence of mechanical ventilation. During periods of ERV operation, the air exchange rate increased from 0.1 to 0.4 ACH, CO_2 levels were kept below 1,000 lIL/L throughout the house, radon concentrations were reduced by about 50 percent, and HVAC/ERV energy consumption increased by 15 to 20 percent.(orig.)

21783 (NEI-FI–222-Vol.5, pp. 85-90) **Mixed-gas or CO_2 sensors as a reference variable for demand-controlled ventilation.** Meier, S. (Staefa Control System AG, Staefa (Switzerland). Research Dept.). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The purpose of the investigation was to gather information about the currently available types of sensor with regard to their suitability for providing a reference variable for demand-based ventilation, and to be able to estimate the associated energy-saving potential. To this end, the air quality was measured continuously for a week in each of the following areas at the University of Zurich: the staff restaurant, a lecture hall for 300 people, and a large sports hall. The sensors used to measure indoor air quality were mixed-gas sensors and CO_2 sensors. In order to evaluate the effect of temporarily switching off the ventilation system, the plant was operated manually at times. It was found that, compared with conventional time-switch control, significant energy savings can be made by operating the plant on the basis of air quality demand, and that this does not significantly affect the comfort of users of the spaces. CO_2, released by respiration, serves as an indicator for the presence of people. Mixed-gas sensors respond to oxidisable gases and vapours. In addition to body odours, therefore, these sensors also measure the majority of other variables which affect air quality. In a subsequent phase, the ventilation systems in the staff restaurant and sports hall will be operated on a demand basis, using mixed-gas sensors for the reference variable, so that the actual energy savings achievable can be quantified.(orig.)

21784 (NEI-FI–222-Vol.5, pp. 115-120) **Infiltration, indoor air quality and energy savings in Israeli apartment buildings.** Poreh, M. (Technion-Israel Inst. of Tech., Haifa (Israel)); Trebukov, S.; Hassid, S.; Wegner, D. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Air infiltration rates in israeli apartments have been investigated as part of a project sponsored by the israeli Ministry of Energy. Widely varying values of effective leakage area, from 1.5 to 14 cm^2/m of crack length, were recorded; the 'leakiest' apartments being the ones with wood windows and slat-type windows. The results of a developed multi-zone air movement model show that the wind speed has the highest influence on the rate of infiltration, and that tight main entrance doors and tight staircase windows, together with an open top staircase vent, give the best results from the point of view of both indoor air quality and energy savings. It is also shown that in israeli apartments the minimum fresh air requirements cannot be satisfied by infiltration alone, for a considerable portion of the time, thus setting a limit on potential energy savings available by improved air tightness. Weather-stripping and other improvements in air tightness can significantly affect maximum heating energy demand, which is of considerable importance for electrically heated apartments, particularly in the windy mountain region.(orig.)

21785 (NEI-FI–222-Vol.5, pp. 121-126) **Evaluation of mechanical domestic ventilation systems: the French approach.** Riberon, J. (Centre Scientifique et Technique du Batiment, Marne la Vallee (France). Heating, Ventilation and Air Conditioning Dept.); Villenave, J.G.; Millet, J.R. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

In France, the ventilation must continuously supply fresh air to the habitable rooms and exhaust stale air from the service rooms. The ventilation rate should be adjustable to the needs of the requirements for the heat loss due to ventilation are set in the French regulation for new residential buildings. A simplified calculation method has been developed to take into account building characteristics (air leakage), ventilation systems and meteorological data. We describe detailed numerical simulations, using CSTB tools, have been used to define such a method to assess directly the performances of the innovative ventilation systems. Research is now going on for determining the best indoor air quality criteria, especially for DCV systems responding to airborne contaminants.(orig.)

21786 (NEI-FI–222-Vol.5, pp. 133-138) **The penetration factor and removal rate of the building envelope for SO_2 and NO_2 gas.** Seelen, J. (Polytechnical Inst. and State Univ. (United States). College of Architecture and Urban Studies of Virginia); Leaderer, B.P.; Vorenkamp, J.; Velde, K. te; Wit, M. de. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The study presented here gives an indication of the removal rate of contaminants by the building envelope. To determine this removal rate and the corresponding penetration factor, a model of a residential building was built inside a controlled exposure chamber. SO_2 and NO_2 gases were injected into the supply air of the chamber, and concentrations in both chamber and model were monitored. The experiments indicated that the building envelope removed part of both gases, resulting in lower indoor concentrations. Exposure of the model to NO_2 gas resulted in elevated levels of NO inside (orig.).

21787 (NEI-FI–222-Vol.5, pp. 151-156) **Energy consumption and cost at higher ventilation rates in an office building in Montreal.** Zmeureanu, R. (Concordia Univ., Montreal (Canada). Centre for Building Studies); Zhaonan, M.; Fazio, P. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

This article presents the impact of higher ventilation rates on the energy consumption and cost of a large office building in Montreal, which was evaluated by computer simulation. Four configurations of the VAV system were analyzed: with heat recovery from the exhaust air and the condensers, with heat recovery only from the exhaust air, with heat recovery only from the condensers, and without heat recovery. The amount of outdoor air was either kept constant or was controlled by the mixing temperature. The ventilation rate was assumed to be increased from the actual value to that recommended by the ASHRAE Standard 62-1989 or even higher. On average, the energy consumption increases at a rate of about 2.3 % and the cost by 2.7 % for each increment of 2.5 L/s/person of the ventilation rate, when the system uses a fixed amount of outdoor air. When the outdoor air rate is controlled by the mixing

temperature and the ventilation rate is smaller than 20 L/s/person, the increase of energy consumption and cost is negligible.

21788 (NEI-FI–222-Vol.5, pp. 163-168) **Inducing air via the facade for better comfort.** Engel, P.J.W. van den (Delft Univ. of Technology (Netherlands). Faculty of Architecture). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Most buildings in The Netherlands make use of natural ventilation, often combined with mechanical exhaust. However it is very important to improve the quality of the ventilation and at the same time to look for economical methods to control the comfort in buildings. The aim of this research project is the control of incoming fresh air via the facade by an air inlet (jet or vent). The incoming air stream just underneath the ceiling induces air in a room of an office building or a house and makes use of the 'coanda effect'. The air inlet and the air pressure regulation system reduces draught problems in the cold season, limits overheating in summer by nocturnal ventilation, and reduces noise from outside. The energy consumption by ventilation can be controlled as well. A prototype of an air inlet was tested in a laboratory. The quantity (velocity) and shape (flow visualisation by smoke) of the air flow was measured at variable small differences in pressure. The results of the measurements with the first prototype show that it is possible to get a high velocity of air even in case of small differences in pressure between inside and outside. This high velocity is necessary to achieve a good mixing of cold and warm air in a room. The experiments also show that the internal geometry of the vent can be reduced very much. This information is important to develop a vent with good sound insulation and to allow good architectural designs.

21789 (NEI-FI–222-Vol.5, pp. 301-306) **Numerical modelling of thermal environment in a displacement-ventilated room.** Jacobsen, T.V. (Aalborg Univ. (Denmark). Dept. of Building Technology and Structural Engineering); Nielsen, P.V. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

It is the purpose of this paper to investigate the ability of a k-ϵ turbulence model to predict air flow and comfort conditions in a displacement-ventilated room. Stratification effects, relaminarization and heat flux at walls cause difficulties when CFD is applied and different approaches to overcome these problems are presented. Comparative studies between ordinary versus extended turbulence models are carried out and the effect of applying different types of temperature boundary conditions is shown. The exchange of radiative energy between the surfaces of the room and the heat flux at the walls are included to complete the description. The results show promising features and it is shown how the distribution of percentage dissatisfied occupants in the room can be obtained by combining criteria of human comfort and CFD results. This offers the opportunity to point out critical areas (orig.).

21790 (NEI-FI–222-Vol.5, pp. 355-358) **Influence of air distribution on energy consumption by HVAC systems.** Rymkievich, A.A. (Technological Inst. of Refrigeration Industry, St.Petersburg (Russian Federation)); Grimitlyn, M.I. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The paper analyses the influence of uneven temperature distribution in the ventilated rooms on heat, cold, air and water consumption of the ventilation and air-conditioning systems (orig.).

21791 (NEI-FI–222-Vol.5, pp. 365-368) **Physical simulation of radiant and convective heat exchange in ventilated rooms.** Shilkrot, E.O. (Central Research and Experimental Design Inst. for Industrial Buildings, Moscow (Russian Federation)); Strongin, A.S. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The influence of radiant heat to convective heat ratio in physical simulation of ventilated processes is discussed. The equations for analysis and simulation of ventilating processes in enclosed spaces as well as experimental data received are discussed. Some practical procedures for the ventilation processes simulation are proposed (orig.).

21792 (NEI-FI–222-Vol.5, pp. 377-382) **Maintaining acceptable thermal comfort with a low air temperature, by means of local heating.** Sorlie, R. (SINTEF Applied Thermodynamics, Trondheim (Norway). Div. of Heating and Ventilation); Langnes, T.B.; Hanssen, S.O. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The main objective was to assess the lower room temperature for acceptable thermal comfort of the person seated at the desk, and to assess the energy-saving qualities of the local heater. During the experiments various temperatures, air velocity, radiant flux and thermal asymmetry were all measured. The thermal mannequin was used in order to verify the level of thermal comfort and was constructed in such a way as to be thermally equivalent to a human. The local heater creates a local microclimate with satisfactory thermal comfort for the person seated at the desk, while the temperature in the rest of the room can be as low as 17-18 deg C. Supplementary thermal simulations carried out on computer, showed that it is possible to save heating energy by reducing the general room temperature (orig.).

21793 (NEI-FI–222-Vol.5, pp. 401-406) **Realization of good indoor climate in METOP low-energy office building.** Laine, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Heating and Ventilation); Saari, M. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Good indoor air quality and thermal comfort, as well as low energy consumption were achieved when an environment friendly experimental METOP-office building was built in Espoo, Finland. The prototype building was built by collaboration of Finnish companies using a new Finnish component system building technology. The consumption of heating and cooling energy has been minimized by installation of energy-efficient windows, good CFC-free thermal insulation of the building envelope, the individually-controlled ventilation and room temperatures, heat recovery and energy-storing structures. At the same time, the quality of the indoor air and the indoor climate has been maximized. According to the measurements, there are no problems with the indoor air quality. Concentrations of odours, radon, particles, microbes, VOCs and other chemical compounds were low. Thermal indoor climate was pleasant in winter and in summer. The index of the satisfaction was over 90 %. Ventilation rates may be chosen in each office room from 10 to 40 dm^3/s. The noise level of the ventilation system was low and the lighting level was pleasant. Good indoor air quality, thermal comfort and low energy consumption can be realized simultaneously (orig.).

21794 (NEI-FI–222-Vol.5, pp. 407-412) **Evaluation of two unitary cooling systems for residences in Eilath (Israel).** Arkin, H. (National Building Research Inst., Technion City, Haifa (Israel)); Navon, R. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of

Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

Arid climate such as the one prevailing in the city of Eilath, Israel, is typified by dry and hot summer, a combination that best suits the utilization of evaporative cooling. Consequently, many residences are equipped with desert coolers. Recently however, some occupants tend to use air-conditioners for providing the cooling. This work displays thermodynamic aspects for selecting an economical domestic cooling system for arid regions. It also discusses advantages and drawbacks of using the systems and the consequences of possible improvement of each system. The thermodynamic perspective underscores the different thermodynamic principles, utilized by each cooling system. The economic evaluation is based on the Life Cycle Costing (LCC) of both systems. The analysis also accounts for the strong interrelation between the economic and thermodynamic-climatic aspects (orig.).

21795 (NEI-FI–222-Vol.5, pp. 413-418) **The influence on the arrangement of cooling ceilings on thermal comfort.** Behne, M. (Berlin Univ. of Technology (Germany). Hermann-Rietschel-Inst. for Heating and Air-Conditioning). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

Cooling ceilings have become well known as an alternative to ordinary HVAC-systems, because they can offer a very comfortable room climate in combination with a very economic operation of the plant. In order to get more information about the influence of the arrangement of cooled ceiling areas in rooms with only partly equip Ed ceilings, examinations were made in a test room at the HRI with a cooling ceiling, which was divided in two parts. The arrangements of the heat sources in the room were varied, to test the influence of the buoyant plumes on the flow pattern of the indoor air. Measurements of temperature fields in the test room were made for various combinations of arrangements of cooling surfaces and heat sources. The results lead to the statement, that there are no major problems with thermal comfort in rooms with closed cooling ceilings, whether the entire ceiling is cooled or only one half of it. The places of the heat sources influence the air movement, but there are no uncomfortable room air conditions, if the temperature difference between the fresh supply air and the average indoor air temperature is small (orig.).

21796 (NEI-FI–222-Vol.5, pp. 415-430) **Cool ceiling system: for better control of office building indoor climate.** Laine, T. (Insinoeoeritoimisto Olof Granlund Oy, Helsinki (Finland)). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

Operation of the cool ceiling system was studied using measurements and system simulations. Measurements indicated that condensation is easy to avoid in Scandinavian type of climate. Condensation occurred only during very humid conditions. The average satisfaction with the indoor conditions using the cool ceiling system was higher than with air systems. No draught problems occur Ed. The overall energy efficiency was almost the same in both VAV and cool ceiling systems. Using free cooling it is possible to reduce electricity consumption of compressors by 30 % in office buildings. In Finland cool ceiling system is the cheapest alternative for office building air conditioning system with individual control (orig.).

21797 (NEI-FI–222-Vol.5, pp. 437-442) **Measurement of office buildings equipment loads.** Metsi, P. (Insinoeoeritoimisto Olof Granlund Oy, Helsinki (Finland)); Pihala, H.; Wilkins, C.K. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

The heat generated by office equipment is an important factor in determining a building's air-conditioning load. During the recent years computers have become more commonly used and their relative share of the peak air-conditioning load has increased. The actual power values of various office equipment were measured and the results were compared to power ratings from manufacturers. Results showed, that office equipment manufacturers' power ratings were clearly higher than the actual measured values. Desktop computers consumed only 20 - 30 % of the rated values. With laser printers the value was 28 - 32 % and with copiers 75 - 95 % during warm-up and copying modes and 5 - 20 % while idle. The load profiles of office equipment were measured in an existing office building in Finland The measurements indicated, that the office equipment power levels were lower than typically estimated. The office equipment power level in a typical office floor, which was mostly open office type was 3.0 - 6.8 W/m^2. Peak consumption was 6.8 W/m^2 and average consumption during the working hours was 4.8 W/m^2. Using the manufacturers' inaccurate power ratings and not considering the typical usage factors of office equipment in air-conditioning sizing results in over-design. Over-designing increases investment costs as well as energy consumption of air-conditioning systems. In some cases it can also cause indoor air quality problems as too low inside temperatures and draught (orig.).

21798 (NEI-FI–222-Vol.5, pp. 449-454) **The influence of the buried heat exchanger on thermal comfort in residential premises in the summer.** Trumper, H. (Dortmund Univ. (Germany). Fachgebiet Technische Gebaeudeausreustung); Hain, K.; Albers, K.J.; Wirth, S. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

An installation for controlled domestic ventilation using a buried heat exchanger is proposed to slightly cool and dry the supply air and thus lower the interior heat levels. This installation is a pipe buried in the ground, and through it the supply air for the residential building is drawn. In summer, the external air drawn in is cooled slightly and dried when the temperature falls below the dew point. Measurements were conducted on such an installation for controlled domestic ventilation with a buried heat exchanger, which was operated over three summer periods. The results are shown in h,x-diagrams. The supply air, which in summer is clearly cooler and drier than the outside air, gives rise to a more comfortable room climate (orig.).

21799 (NEI-FI–222-Vol.5, pp. 455-460) **An experimental study on transient thermal behaviour of new hydronic radiant floor heating systems.** Chung, Kwang Seop (Seoul National Polytechnic Univ., Seoul (Korea, Republic of). Dept. of Architectural Engineering); Ahn, Byung Wook; Park, Byung Woon; Baik, Yong Kyu. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.
Published in 6 volumes.

This study presents some details of the transient thermal responses of Ondol-heated spaces by experiments. Also, it reports the temperature responses and the thermal storage performance of floor heating panels with the different 'Ondol' structures. The experiments were performed at a specially designed model house, in which consists of the four test rooms. Results were as the follows: The thermal mass storage capacity of traditional on-site panel was larger than those of new pre-fab panels. In addition, the pre-fab panels were the better energy saving structures than tile on-site panel, even if they had the lower thermal storage capacity (orig.).

21800 (NEI-FI–222-Vol.5, pp. 461-466) **Comparison between the performance of task and zonal environmental control systems in office buildings.** Croome, D.J. (Univ. of Reading (United

Kingdom). Dept. of Construction Management and Engineering); Swaid, H. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The principal benefits from using user-controlled, localized environmental systems (UCLES), namely effecting energy savings in buildings and maintaining improved comfort conditions are discussed. Furthermore, a pragmatic understanding of human thermal comfort under dynamic field conditions and personal environmental control is advocated. A simple room heat-budget model is presented indicating that energy savings of up to 30 % could be achieved by using UCLES instead of down-flow (mixing) air conditioning systems (orig.).

21801 (NEI-FI–222-Vol.5, pp. 467-472) **Experimental office building: Results of indoor air monitoring.** Gabrielsson, J. (Climaconsult Ltd, Espoo (Finland)); Wiljanen, H. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

In the experimental office building of Climaconsult Ltd two different air conditioning systems were tested and monitored two years. One integrated in the raised floor and working with water loop heat pump units, the other integrated in the false ceiling and working with water cooled AC-beams. Thermal indoor conditions were found to be good in both systems although the floor supply in the floor integrated system caused some drafts in summer. Indoor air quality was also measured but is reported separately. Energy consumption was found to be higher in the heat pump system (orig.).

21802 (NEI-FI–222-Vol.5, pp. 473-478) **Comparison of thermal comfort of three heating systems: field measurements.** Haghighat, F. (Concordia Univ., Montreal (Canada). Centre for Building Studies); Auger, M. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The performance of three heating systems with respect to thermal comfort based on data collected over two heating season in a three-storey building was measured. The three heating systems tested included: a modular, a forced air and a hadronic system. The systems were also compared with respect to temperature response. Results showed that all the systems produced fairly good environment in terms of thermal comfort parameters and temperature response with only small differences between the systems. The results did not show any major problems which could occur from the point of view of comfort if the centres of the rooms are considered (orig.).

21803 (NEI-FI–222-Vol.5, pp. 483-488) **The effect of indirect evaporative cooling on thermal environment.** Koskela, H. (Turku Regional Inst. of Occupational Health, Turku (Finland)); Hautalampi, T.; Soini, S.; Pentti, J.; Minni, E.; Rolin, I.; Ekman, C. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The aim of the study was to determine the effect of ventilation improvements on the perception of the thermal environment in an industrial hall. The study consisted of a questionnaire and measurements of thermal environment, which were repeated four times. The ventilation and air distribution system of the hall was changed. The new system included indirect evaporative cooling during summer period. The questionnaire was filled up twice before and twice after the technical change. Ventilation improvements proved to have a positive effect on the perceived thermal environment especially during cooler periods. The percentage of dissatisfied remained at the level of 20 % during cooler periods and 50 - 70 % during warmer periods (orig.).

21804 (NEI-FI–222-Vol.5, pp. 495-500) **Closed loop heat pump as an energy saver in office buildings.** Murtopuro, M. (Tekivo Oy, Helsinki (Finland)). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The closed loop heat pump system collects excess heat room by room and stores it into a water loop. The stored energy will be utilized also room by room. The measurements have shown that it saves energy by reducing the demand of external heating energy. Also the cooling process does not cause any loss of energy because of local direct evaporation type of function. A parallel function of cooling and heating in the same room is in this system prohibited. The total energy saving depends on the internal energy consumption in the building. In the demonstration system an energy saving of appr. 10-14 kWh/building m^3 has been measured (orig.).

21805 (NEI-FI–222-Vol.5, pp. 533-538) **Simulations of indoor air quality and comfort in multi-zone buildings.** Adams, E.W. (United Technologies Research Center, East Hartford, CT (United States)); Sgamboti, C.L.; Sherber, M.; Thompson, J.L. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

Strategies for indoor air quality (IAQ) improvement often impact building energy use. The optimum strategy for indoor air quality requires a trade-off between improving IAQ and increasing energy use to attain it. Modelling can be particularly effective in defining the optimal strategy for a particular site. Modelling IAQ for building applications requires at least four different modelling efforts; (1) human dose-response relationship, (2) building pollutant load analysis, (3) operating cost and (4) dynamic IAQ prediction. Effective design of control systems and operating strategies in IAQ mitigation equipment requires dynamic simulation of typical applications, including adsorption/desorption effects for pollutant species. The coupling of energy analysis to IAQ analysis shows the energy savings available from using heat recovery combined with increased ventilation for the solution to IAQ problems. Sample calculations show that ventilation rates must be high to limit pollutant transport between zones. Ventilation must continue long after an event to limit discomfort (orig.).

21806 (NEI-FI–222-Vol.5, pp. 551-556) **General flow- and thermal-boundary conditions in indoor air flow simulation.** Li Yuguo (National Inst. of Occupational Health, Solna (Sweden). Ventilation Div.); Holmberg, S. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1993. (CONF-930701–Vol.5: 6. international conference on indoor air quality and climate, Helsinki (Finland), 4-8 Jul 1993). In *Indoor Air '93. Ventilation: Proceedings.* 600p. Order Number DE94771055. Source: OSTI; NTIS.

Published in 6 volumes.

The concepts of general flow- and thermal-boundary conditions are introduced to treat interaction between indoor and outdoor thermal environments in Computational Fluid Dynamics (CFD) simulations. The results from a multi-zone model are used to supply the general flow boundary conditions. The energy balance equation at wall-air interface is used to supply the general thermal boundary conditions. An example calculation in a 13-room building shows that infiltration influences indoor air flow patterns considerably. The air flow in a room with two surface coatings ventilated by displacement is measured and simulated. Implementation of these two boundary conditions is essential in predicting air flow pattern, air quality, and thermal comfort in a real building (orig.).

21807 (NEI-FI–230) **New electrical installation systems: Final report.** Rantala, E. Technology Agency Oy, Espoo (Finland). 1993. 22p. (In Finnish). Project KTM-34/881/89. Order Number DE94771059. Source: OSTI; NTIS.

LVIS-2000 Research Programme.

The long term objective of the New Electrical Installation system -project (USAJ) was to develop a flexible electrical distribution system for buildings. The new system is part of, HVAC-2000, a five-year research project, financed by the Ministry of Trade and Industry. To obtain the objective the project was divided into research and product development projects covering an interval of several years and was designated to cover several levels. The Visionary phase resulted in obtaining the operating principles and specifications for an electrical installation system which takes into account the European installation systems and is competitive as far as functionality and cost structure are concerned. Altogether 42 different products were developed in the project and in the project following it. There were four systems which were already on the market or as prototypes: Cable channel system equipped with flexible snab-on techniques, snab-on electric harnesses, control system for the use of electricity and a track system for luminaries. In addition 62 different research and test reports were obtained. 12 Finnish and 9 Norwegian companies participated in the EUREKA 432 project which was a clear outcome of this project. It concentrated on developing an electrical distribution system where for example socket outlets, electrical radiators etc. can be moved easily from one place to another. There were four pilot test sites: TAT-testhouse, the house of Archimedes, Metop and Nestehouse. The objective in these buildings was, one way or another, to develop a control system for the use of electricity.

21808 (ORNL–6797, pp. C.1-C.19) **The success of hydrocarbons in domestic refrigeration: Energy efficient and environmentally friendly.** Doehlinger, M. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Following the CFC ozone crisis independent scientists and technicians in the refrigeration field have become very sceptical regarding synthetic refrigerants' long term compatibility with nature and human health, despite extensive testing of the materials. Natural, non-synthetic substances such as water, carbon dioxide, ammonia and hydrocarbons are efficient and safe refrigerants. There is long term experimental data for these substances for air conditioning and refrigeration. In the last year hydrocarbon-based domestic refrigeration has been developed significantly and major advances in efficiency and performance have been proven in the field. Such fridges are now on the market in Europe having passed all official safety and efficiency requirements.

21809 (ORNL–6797, pp. C.105-C.111) **Ammonia/water absorption systems.** Marsala, J. (Gas Research Institute, Chicago, IL (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Ammonia/water absorption systems are heat actuated devices which accept heat at high and low temperature levels and reject heat at intermediate temperature levels. As a closed-cycle, heat-actuated device, ammonia/water adsorption systems are bounded theoretically by dual Carnot limits and cycle stage limits, however, in practice, other mechanisms dictate performance levels. The simplest continuously operating two pressure NH_3/H_2O absorption system consists of four components and a solution pump. Analogous to vapor compression systems, the ammonia/water absorption system has an evaporator where liquid ammonia is vaporized and heat is added to the cycle, and a condenser where high pressure ammonia vapor is condensed and heat is rejected. Ammonia/water absorption systems are currently used in residential and light commercial air conditioners, domestic type refrigerators, and in large industrial refrigeration applications.

21810 (ORNL–6797, pp. C.113-C.121) **Lithium bromide absorption chillers.** Kohler, J.A. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Absorption chillers using lithium bromide as the absorbent and water as the refrigerant have been in use for many years. Such chillers are classified as single effect or double effect. Absorption chillers are heat driven and are classified by heat source as direct-fired, steam-fed, or heat recovery. They compete in the same market with electrically driven vapor compression equipment. The economics of absorption versus vapor compression is heavily influenced by fuel costs, utility rate structures, and incentives. This has led to an up and down market for these chillers. Improvements in the design of single and double effect chillers will continue as competition forces manufacturers to reduce cost and improve performance. Improvement in COP for such chillers is possible, but limited. Substantial improvements in COP require use of systems, such as the triple effect cycles, which allow for heat input at higher temperatures and effective internal heat exchange. A variety of triple effect cycles are possible. Different costs and different COPs are to be expected with each version. The practicality of such equipment will ultimately be decided by an ability to demonstrate reduced life cycle costs versus other commercially available equipment.

21811 (ORNL–6797, pp. C.123-C.131) **Vapor compression cycle with solution circuit.** Groll, E. (Univ. of Maryland, College Park, MD (United States)); Radermacher, R. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The principle of vapor compression cycles with solution circuits (VCCSC) has been known in the literature for about 100 years. The first theoretical investigations were carried out by Altenkirch and indicated a large energy savings potential. Based on this potential and the additional need to replace the ozone depleting CFCs, the research activities toward the VCCSC have increased rapidly during the last 10 to 25 years. The VCCSC is a vapor compression cycle, which employs a working fluid mixture consisting of a refrigerant and an absorbent, which are characterized by a large boiling point difference. The evaporation of the mixtures is not complete so that the fluid leaving the desorber is a vapor/liquid mixture. Vapor and liquid are usually separated at the desorber outlet. While the vapor proceeds to the mechanically driven compressor, the liquid is recirculated to the absorber with a solution pump in a separate liquid line. Both, vapor and liquid meet again at the inlet of the absorber. There are two major differences between the conventional compression cycle and the VCCSC employed here. The first is the usage of a mixture of working fluids instead of a pure fluid. The second is that the mixture does not evaporate completely. By introducing a working fluid mixture two important features are accomplished. First, although desorption and absorption occur at constant pressures, the saturation temperatures are no longer constant but vary with the composition changes of the liquid and the vapor phases which occur during the phase change processes. This results in the so-called 'gliding temperature intervals'. Second, a change in the overall concentration of the mixture circulating through the cycle results in a change of the vapor pressures and densities at a given temperature and therefore in a change of the capacity of the entire unit. Both of these features can be used to increase the overall COP compared to conventional compression systems.

21812 (ORNL–6797, pp. C.151-C.164) **Development of desiccant cooling systems utilizing low temperature regeneration.** Coellner, J.A. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO

(United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

ICC Technologies has developed a desiccant based cooling system which promises to overcome the capacity, efficiency, and cost barriers which have overwhelmed previous projects. The system utilizes the classic Munters Environmental Control (MEC) component arrangement. A recirculation rather than a ventilation operating mode is presented as the primary configuration. The success of the design rests on the ability of the desiccant rotor to provide low dewpoint air when regenerated at low temperature, the effectiveness of the regenerative heat exchanger, and the integrity of construction. ICC has entered a Joint Development Agreement with Engelhard Corporation to utilize Engelhard's ETS zeolite in a desiccant rotor. Engelhard has developed a family of large pored titanium silicate molecular sieves. These octahedral zeolites exhibit properties which are markedly different from tetrahedral aluminosilicate zeolites providing the opportunity to develop a viable desiccant cooling system on a new basis. The goals of the Joint Development Project have been to create desiccant materials and rotors with capacities sufficient to allow for a desiccant cooling device which meets the capacity levels of conventional cooling equipment, to assemble systems which demonstrate the attainment of the performance level, and to fabricate and install prototype systems for field demonstration. The first system configuration is a natural gas fired version with a rating point thermal COP goal of 0.70.

21813 (ORNL–6797, pp. C.165-C.179) **Open-cycle desiccant cooling technology: A pathway to the future.** Belding, W.A. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Over the last four years, LaRoche Chemicals Inc. under a joint research project with the Gas Research Institute, has developed an advanced desiccant wheel for use in open-cycle desiccant cooling systems. The new wheel technology, in conjunction with innovative equipment design shows promise for placing desiccant cooling systems in a competitive position with existing high performance electric vapor compression equipment. In fact, other side benefits of this technology should provide a strong driving force for its acceptance in the air conditioning market place.

21814 (ORNL–6797, pp. C.181-C.190) **Adsorption heat pump development at JPL.** Jones, J.A. (California Institute of Technology, Pasadena, CA (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

In simple sorption refrigeration systems, low pressure gases are physically adsorbed onto or chemically absorbed into various solids, typically near ambient temperature or above. When heated an additional 100 - 300°C, the gases are desorbed, i.e., vented, at substantially higher pressures. When the high pressure gas is precooled and expanded through an orifice, known as a Joule-Thomson valve, the gas becomes partially liquefied and provides net cooling. Heat boils the liquid, and the returning low pressure gas is eventually reabsorbed by the sorbent, thus completing the cycle. The entire refrigeration system has essentially no wear-related moving parts, other than very long life, self-operating, room temperature check valves. Thus life expectancy is many years, possibly decades, and there is essentially no vibration. Since 1979, the Jet Propulsion Laboratory (JPL) has tested numerous hydrogen, oxygen, nitrogen, and krypton cryogenic sorption refrigeration systems for cooling space-based infrared imaging systems. For ground applications, to conserve energy, a number of heat regeneration techniques have been attempted, where-by the waste heat from the sorbent bed is used to heat another sorbent bed. Simple double bed systems have been developed, in which a hot sorbent bed that is being cooled will pass its heat to a coolant fluid which then passes through a heater (to make up for regeneration thermal losses) and then on to another sorbent bed. Extensive studies performed at JPL show that a four bed approach is much more efficient than two beds, but there is not significant advantage in using more than four beds. Applications for the regenerative heat pump are air conditioning, heating, and refrigeration.

21815 (ORNL–6797, pp. C.191-C.196) **CFC-free chemisorption heat pumps and refrigeration.** Ryan, W.A. (Gas Research Institute, Chicago, IL (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Chemisorption is a solid-vapor adsorption cooling system utilizing ammonia refrigerant. The refrigerant experiences the same evaporation and condensation process as in a conventional cooling system, but the compressor is replaced by a solid mass of ammoniated salt. This salt adsorbs ammonia at low pressures. When heated, the salt desorbs ammonia at high pressure, thereby acting as a compressor. In a simple chemisorption cycle heat is used to drive the ammonia refrigerant out of the ammoniated salt. The ammonia is then condensed in an air cooled coil, reduced in pressure, and evaporated producing a cooling effect. The low pressure ammonia vapor is then adsorbed into a second salt adsorber. In this simple cycle, both adsorbers contain the same salt, and the heat of adsorption is rejected. Once all the ammonia is passed from one adsorber to the other, the heat source switches to heating the full adsorber, a four way valve switches and the cycle continues. Liberating ammonia refrigerant from an ammoniated salt does require more heat than freeing refrigerant in other solid-vapor systems. This is due to the relatively tighter bonding in the ammoniated salt complex. Therefore, in a simple adsorption/desorption cycle, efficiency would be relatively poor. However, with the variety of salts available, more efficient cycles can be utilized. Different salts adsorb and desorb ammonia at different temperatures.

21816 (ORNL–6797, pp. C.21-C.23) **Free-piston stirling and rankine cooling.** Berchowitz, D.M. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Two applications of the free-piston/linear motor technology are described, namely: free-piston Stirling coolers and free-piston Rankine (vapor compression) compressors. Free-piston Stirling coolers employ the Stirling cycle for cooling, which under ideal circumstances of isothermal heat transfer, has Carnot efficiency. This cycle operates entirely in the gas phase, so none of the typical refrigerants are required (such as CFC's and HCFC's). Helium or a non-explosive Hydrogen gas mixture is used. Proper motion of the moving parts is obtained by utilizing the pressure forces developed by the cycle. There is no crank shaft, connecting rod or any other kinematic components. Only two moving parts are required. Since side loads are extremely small, gas bearings are used which ensure noncontact operation and high mechanical efficiencies. Since the amplitude of a linear motor is directly proportional to the drive RMS voltage, modulation of lift is possible by controlling input voltage. Units are hermetically sealed. Free-piston Rankine compressors are conventional refrigerator compressors in which the drive motor has been replaced by a linear motor. Again, since side loads are very small, gas bearings are used which allows the use of oil-free operation. The removal of the kinematic mechanism and the oil lubrication results in a much higher mechanical efficiency and hence overall efficiency. Owing to the flexibility of amplitude and mean position (controlled by a DC voltage), these machines are able to tolerate a wide variety of refrigerants without modification. Modulation of lift is obtained by controlling the input RMS voltage.

21817 (ORNL–6797, pp. C.215-C.222) **Metal hydride heat pumps.** DaCosta, D.H. (Ergenics Inc., Ringwood, NJ (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO

(United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

There are a number of metals that possess the remarkable ability to absorb large quantities of hydrogen gas. The hydrogen combines with the metal to form a "solid solution" which is, in effect, a new metal alloy. Hydrogen absorption occurs under specific temperature and pressure conditions. The hydrogen is released (desorbed) when the alloy temperature is elevated or the pressure is reduced. The absorption/desorption phenomenon is a reversible reaction and the metals that absorb hydrogen are called reversible metal hydride alloys. When a reversible metal hydride alloy absorbs hydrogen gas, heat is given off; the reaction is exothermic. In order to desorb hydrogen from the metal alloy, heat is required. If the desorbing alloy takes its heat from ambient temperature air, the air temperature decreases, thus producing the refrigeration associated with air conditioning. Ergenics Inc. specializes in metal hydride alloy technology and its application for hydrogen storage, thermal compression, rechargeable batteries and heat pumps. Ergenics is in the process of quantifying performance characteristics of a metal hydride bench top prototype air conditioner with a cooling capability of 8000 BTU/HR. The energy source for the prototype is a hot air stream. Values for size, weight and performance that are presented in this paper are based on this bench top prototype.

21818 (ORNL–6797, pp. C.223-C.228) **Solid sorption gas heat pump technology.** Shelton, S.V. (Georgia Institute of Technology, Atlanta, GA (United States)); Sanborn, D.M.; Miles, D.J. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Solid sorption has important fundamental features which make it advantageous for space conditioning. These fundamental merits coupled with new regeneration technology make it a strong candidate to capture the long sought after advantages of direct fossil fuel fired space conditioning in conjunction with benign refrigerants. New solid sorption technology shows advantages including: simplicity, low maintenance, high temperature heat input capability, low pump power, inherent flexibility in operation, heating performance insensitivity to low winter ambient temperature, and environmentally friendly refrigerants. Minimum market volumes of 50,000 units per year must be achievable for a new gas heat pump product to make it attractive to an HVAC manufacturing and distribution company. Initial market introduction should be prudently small and built up over a few years. Market analyses by outside HVAC industry marketing specialists shows that significant market penetration is achievable with the current product technology concept to be commercialized in 1996. One benefit of this technology is that the theoretical potential is much higher than necessary for successful product introduction. Further development and system optimization is possible with second and third generation products based on this technology achieving increasing penetration of the 2 to 3 million residential heating/cooling systems sold annually.

21819 (ORNL–6797, pp. C.229-C.238) **Ejector expansion refrigeration cycle.** Silvetti, B. (Calmac Manufacturing Corp., Englewood, CO (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

A significant breakthrough is underway which promises to improve the efficiency, capacity, and maximum thermal differential for a wide range of vapor compression refrigeration systems. It is applicable to cooling, heating, and refrigeration systems in all sizes. The breakthrough is called the Ejector Expansion Refrigeration Cycle (EERC). One of the intrinsic losses in the standard vapor compression refrigeration cycle is the throttling of refrigerant in the expansion device. In the EERC, the energy normally wasted in thermal expansion valves, capillary tubes, and orifices is used positively by means of an ejector to raise the suction pressure entering the compressor. Since work done by the ejector replaces wasteful throttling, the evaporator cooling effect increases while compressor work decreases. The results are increases in both efficiency and capacity. These improvements are attained by the addition of low cost components having no moving parts. They are applicable to all vapor compression refrigerants, including new ozone-safe compounds.

21820 (ORNL–6797, pp. C.25-C.33) **Stirling cycle refrigeration.** Riggle, P.; Penswick, B. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The Stirling cycle was selected from alternative candidate technologies because it is environmentally acceptable, has the potential for long maintenance-free life, high COP, and acceptable manufacturing cost. The free piston Stirling refrigerator employed has three moving assemblies, each supported by flexural bearings. The flexural bearings rely on the concept of the endurance limit to provide essentially infinite life and a statistically predictable failure rate. In this application the flexural bearings are able to maintain clearance seals with about one mil of radial clearance. With this amount of radial clearance the seal leakage effects are acceptable and there is no rubbing between piston and cylinder surfaces. No lubricants are required. The theory of linear motors indicates that the best motor efficiency occurs when the piston and motor armature assembly is in mechanical resonance at the operating frequency. Therefore, the design is specified to assure that the spring effects provided by the armature support flexural bearings, and by the gas spring effects of the working gas and the gas in the motor compartment, are just right to resonate the effective moving mass of the piston and motor armature assembly. The displacer operates as a freely oscillating mass spring damper assembly driven by the oscillating pressure of the working gas. The displacer is sprung by the displacer flexural bearings. The displacer is damped by windage effects of gas flowing through the heat exchangers.

21821 (ORNL–6797, pp. C.59-C.65) **Magnetic refrigeration.** DeGregoria, A. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Magnetic refrigeration exploits the magneto-caloric effect, in which, certain magnetic materials adiabatically warm upon application of a magnetic field and cool upon removal of the magnetic field. There are many magnetic materials for which this process is highly reversible. One such material is gadolinium metal. Its maximum adiabatic temperature rise is about 2 degrees C per Tesla of applied magnetic field which occurs around room temperature (20 C). For near room temperature applications, temperature spans of tens of degrees C are typically required. Large cryogenically cooled superconducting magnets can produce peak fields of approximately 7 Tesla. Regeneration is utilized to increase the temperature span to the desired value. The superconducting magnet is in persistent mode and it sees no time varying magnetic environment. It, therefore, requires no power supply to maintain the field. A cryogenic cooling system is needed, however. This limits the application of the technology to large scale refrigeration and air conditioning (hundreds of tons) since the power to the cryocooler can be from 1 to 5 KW. This is an estimate based on current technology. The development of high temperature superconducting magnets operating at 40 K rather than 4 K will reduce this parasitic load by more than an order of magnitude. The main benefit of the technology is higher efficiency than the current vapor compression technology and, as a consequence, reduced operating cost.

21822 (ORNL–6797, pp. C.67-C.75) **An overview of evaporative air conditioning technologies and contributions towards reducing CFC and energy usage.** Foster, R.E. (New Mexico State Univ., Las Cruces, NM (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge

National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Evaporative air conditioning is the most underutilized air conditioning technology available in the United States. Evaporative air conditioning is the cooling effect provided by the adiabatic evaporation of water. Two principle methods of evaporative air conditioning are commonly used: direct cooling, in which water evaporates directly into the airstream, indirect cooling, where primary air is cooled sensibly with a heat exchanger, while the secondary air carries away the heat energy from the primary air as generated vapor. Direct and indirect processes can be combined (indirect/direct). Compared to vapor compression systems, increased air flowrates are used for direct evaporative comfort cooling to compensate for higher supply air temperatures. Evaporative air conditioning is a commercially available technology that today is contributing worldwide towards diminishing the use of CFCs and reducing greenhouse gas emissions from power plants. Applications such as direct and indirect evaporative air conditioning, as well as direct and indirect precooling, are providing these contributions. Advances in desiccant technologies should further contribute to the growth of evaporative air conditioning technologies outside of traditionally arid zones.

21823 (ORNL–6797, pp. C.85-C.92) **Technology growth of fluorocarbon vapor compression systems.** Glamm, P. (Trane Co., LaCrosse, WI (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

This paper provides a look at the air conditioning industry from the perspective of the conventional fluorocarbon vapor compressor systems. The air conditioning industry is very interested in alternate cycles, as they continually look for a technology which may obsolete fluorocarbon vapor compression products. Although some alternate cycles appear very promising, they seem to have stayed about 10 years from commercial viability over several decades, with the exception of absorption and desiccant systems. The trends in cost/performance ratios of vapor compression products have been strongly influenced by improvements in technology and reductions in the cost of doing business. Simple engineering models cannot forecast these long term trends with any accuracy. Technology changes generally require large sums of money for development and implementation costs. Vapor compression systems have not reached their thermodynamic limits in performance, and a wide array of feasible concepts for improving their performance are being investigated. This technology is not standing still. Thus leading to the recommendation that careful thought should be given to the methods of comparing the different cooling technologies with an efficiency/global warming perspective, especially if one attempts to compare the technologies at similar cost levels. This analysis should be repeated as often as necessary so the effects of unanticipated technology improvements and practical limitations are factored into the results.

21824 (ORNL–6797, pp. C.93-C.103) **Fluorocarbon vapor compression technology status.** Sundaresan, S.G. (Copeland Corp., Sidney, OH (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

This article provides a glimpse of the technology advances being pursued by the vapor compression sector of the air conditioning market. They are identifying and evaluating refrigerant options to use as replacements for conventional chlorocarbon refrigerants. They are also studying the performance of polyol esters as synthetic lubricants for use with these new refrigerants. Simultaneous with this development work, improvements are being accomplished in the performance of units by new compressor designs, and efficiency improvements in compressor components.

21825 (ORNL/M–3253) **Thermal resistance of attic loose-fill insulations decreases under simulated winter conditions.** Graves, R.S.; Wilkes, K.E.; McElroy, D.L. Oak Ridge National Lab., TN (United States). May 1994. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012502. Source: OSTI; NTIS; GPO Dep.

Two absolute techniques were used to measure the thermal resistance of attic loose-fill insulations: the Large Scale Climate Simulator (LSCS) and the Unguarded Thin-Heater Apparatus (UTHA). Two types of attic loose-fill insulations (unbonded and bonded/cubed) were tested under simulated winter conditions. To simulate winter conditions for an attic insulation, the specimens were tested with heat flow up, large temperature differences, and an air gap. The specimens were tested either with a constant mean temperature (30 or 21°C) and an increasing temperature difference or with a constant base temperature (21°C) and an increasing temperature difference (i.e., a decreasing mean temperature). The UTHA test specimens had a nominal thickness of 0.2 m of loose-fill insulation. The LSCS test specimens had a nominal thickness of 0.3 m of loose-fill insulation contained in a 4.2 by 5 m attic test module with a gypsum board base. The module had a gabled attic with a 5 in 12 slope roof. The tests yielded the surface-to-surface thermal resistance, R, which includes the thermal resistance due to gypsum, insulation, and any wood joists. Tests with and without an air gap were conducted in the UTHA. Surface-to-surface thermal resistance results from the LSCS and the UTHA show similar trends for these two types of loose-fill insulation when tested under simulated winter conditions. Tests with no air gap gave values of R that agreed with the bag label R-value for the insulations; R increased with lower mean temperatures. These no-gap values of R were 2 to 5% greater than the values of R obtained with an air gap for temperature differences of less than 22°C. For larger temperature differences R decreased, and at temperature differences of over 40°C, the R values were 50% less than those at small temperature differences.

21826 (PNL–9386) **A history of the Building Energy Standards Program.** Shankle, D.L.; Merrick, J.A.; Gilbride, T.L. Pacific Northwest Lab., Richland, WA (United States). Feb 1994. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012774. Source: OSTI; NTIS; GPO Dep.

This report describes the history of the Pacific Northwest Laboratory's (PNL's) work in development of energy standards for commercial and residential construction in the United States. PNL's standards development efforts are concentrated in the Building Energy Standards Program (the Program), which PNL conducts for the U.S. Department of Energy (DOE) Office of Codes and Standards. The Program has worked with DOE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), and other building codes and standards organizations to develop, evaluate, and promulgate energy standards in all sectors of the building industry. This report describes the recent history of U.S. code development and PNL's contributions through the 1980s and early 1990s, up to the passage of the Energy Policy Act of 1992. Impacts to standards development resulting from the passage of this act will be described in other reports.

21827 (PNL–9792) **Carbon-dioxide-controlled ventilation study.** McMordie, K.L.; Carroll, D.M. Pacific Northwest Lab., Richland, WA (United States). May 1994. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012776. Source: OSTI; NTIS; GPO Dep.

The In-House Energy Management (IHEM) Program has been established by the U.S. Department of Energy to provide funds to federal laboratories to conduct research on energy-efficient technology. The Energy Sciences Department of Pacific Northwest Laboratory (PNL) was tasked by IHEM to research the energy savings potential associated with reducing outdoor-air ventilation of buildings. By monitoring carbon dioxide (CO_2) levels in a building, outdoor air provided by the heating, ventilating, and air-conditioning (HVAC) system can be reduced to the percentage required to maintain satisfactory CO_2 levels rather than ventilating with a higher outdoor-air percentage based on an arbitrary minimum outdoor-air setting. During summer months, warm outdoor air

brought into a building for ventilation must be cooled to meet the appropriate cooling supply-air temperature, and during winter months, cold outdoor air must be heated. By minimizing the amount of hot or cold outdoor air brought into the HVAC system, the supply air requires less cooling or heating, saving energy and money. Additionally, the CO_2 levels in a building can be monitored to ensure that adequate outdoor air is supplied to a building to maintain air quality levels. The two main considerations prior to implementing CO_2-based ventilation control are its impact on energy consumption and the adequacy of indoor air quality (IAQ) and occupant comfort. To address these considerations, six portable CO_2 monitors were placed in several Hanford Site buildings to estimate the adequacy of office/workspace ventilation. The monitors assessed the potential for reducing the flow of outdoor-air to the buildings. A candidate building was also identified to monitor various ventilation control strategies for use in developing a plan for implementing and assessing energy savings.

21828 (PNL-SA–23871) **Pacific Northwest Laboratory's Lighting Technology Screening Matrix.** Harris, L.R. (USDOE, Washington, DC (United States)); Stucky, D.J.; Dirks, J.A.; Schultz, R.W.; Shankle, S.A.; Richman, E.E.; Purcell, C.W. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940443–2: Globalcon: congress and exhibition for energy and environmental technologies, Anaheim, CA (United States), 6-7 Apr 1994). Order Number DE94012504. Source: OSTI; NTIS; GPO Dep.

Pacific Northwest Laboratory has developed the Lighting Technology Screening Matrix (LTSM), a software tool to evaluate alternative lighting retrofit technologies according to life-cycle cost. The LTSM can be used to evaluate retrofits for most configurations of fluorescent, incandescent, high- and low-pressure sodium, metal halide, mercury vapor, and exit lighting systems for any level of operation, electricity price, discount rate, and utility rebate. This tool was developed, in support of the Federal Relighting Initiative as part of the Department of Energy's Office of Federal Energy Management Program (DOE/FEMP) to assist federal government facilities in their efforts to comply with the 10 CFR 436 mandated life-cycle costing for energy equipment investments. The LTSM has been used in the course of seven site modernization projects. These projects consisted of determining the cost-effective, energy-efficiency potential at military installations. Each project treated the entire military installation as an integrated system, proposed a large number of potential efficiency projects affecting all end-uses and fuel types, and analyzed the cost-effectiveness of each project. The LTSM was used for the lighting portion of these projects. Lighting was, overall, one of the major areas of potential efficiency improvements, accounting for over 30% of the cost-effective resource. Altogether over $43 million worth of cost-effective efficiency investments were identified, worth an estimated $6 million annually in energy, demand, and operations and maintenance (O&M) savings. This paper describes the LTSM and demonstrates its application in a case study at one of the federal installations analyzed.

21829 (PNL-SA–23877) **Energy efficiency in new buildings: implementing the Energy Policy Act of 1992.** Stockmeyer, M.K. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012243. Source: OSTI; NTIS; GPO Dep.

The Building Energy Standards Program (Program) is conducted for the Department of Energy's (DOE) Office of Codes and Standards, within the Office of Building Technologies. The Program seeks to facilitate the construction of energy efficient, cost-effective, and environmentally sound new buildings through the application of energy efficiency codes and standards. The Energy Policy Act of 1992 (EPAct) requires that the Department of Energy support the voluntary energy standards development process, advocate the use of model energy codes, and provide technical support to states and the federal government in adopting energy efficiency standards for new buildings. In meeting these requirements, Program staff work with a wide variety of stakeholders - particularly designers, builders and code officials - to base codes and standards on the application of sound scientific principles. Further, Program staff work with individuals in the federal government, states, code development organizations, and the buildings community to deploy energy efficient technologies and encourage complementary practices throughout the design and construction processes.

21830 (PNL-SA–23900) **Impacts of electric demand-side management programs on fuel choice: A case study.** Lee, A.D. (Pacific Northwest Lab., Richland, WA (United States)); Kavanaugh, D.C.; Sandahl, L.J.; Vinnard, A.B. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9404101–1: Energy modeling: methodology, models and applications, Atlanta, GA (United States), 25-27 Apr 1994). Order Number DE94012506. Source: OSTI; NTIS; GPO Dep.

Information, rebates, and technical assistance associated with utility demand-side management (DSM) programs can alter consumer behavior. Such programs may unintentionally affect consumer fuel choices. This study addresses fuel choice effects of a unique Pacific Northwest DSM program: (1) it is directed at new manufactured homes only, (2) it is an acquisition program – utilities make $2,500 payments directly to manufacturers for each electrically heated, energy-efficient home built, (3) it has rapidly penetrated nearly 100% of the potential market, and (4) over 90% of the affected homes in the participating region have traditionally used electricity for space heating. Heating equipment data for all manufactured homes built in the region since 1987 were sampled and regression analysis was used to examine the relationship between the DSM program and fuel shares. The quantitative data were supplemented with interview data to better understand the relationship between the program and fuel choice. The results should be useful for program design and evaluation.

21831 (PSI–94-02) **The integrated engineering system for the HVAC branch.** Allenspach, J. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Duppenthaler, A.; Helbling, R.; Kohler, T.; Mantel, R.; Meineke, E. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1994. 141p. (In German). Order Number DE94767460. Source: OSTI; NTIS.

In 1987, the intention of the former Swiss Federal Institute for Reactor Research was to initiate a transfer of know-how into practice by launching this project. The increasing need for software engineering tools by heating, ventilation and air conditioning (HVAC) companies demanded a new tool; to realise it, a joint venture project with private industry should concentrate the individual capabilities of each partner toward this goal. The present report describes the concept of the integrated engineering system, its user interface, the models, graphics, tools, multiuser operation and the system boundary. Results of field tests are presented together with information of the availability of the system. (author) figs., tabs., refs.

21832 (PSI–94-02-Ann.) **The integrated engineering system for the HVAC branch: Annex.** Allenspach, J. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Duppenthaler, A.; Helbling, R.; Kohler, T.; Mantel, R.; Meineke, E. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1994. 230p. (In German). Order Number DE94002069. Source: OSTI; NTIS.

In 1987, the intention of the former Swiss Federal Institute for Reactor Research was to initiate a transfer of know-how into practice by launching this project. The increasing need for software engineering tools by heating, ventilation and air conditioning (HVAC) companies demanded a new tool; to realise it, a joint venture project with private industry should concentrate the individual capabilities of each partner toward this goal. The present report describes the concept of the integrated engineering system, its user interface, the models, graphics, tools, multiuser operation and the system boundary. Results of field tests are presented together with information of the availability of the system. The annex contains the agreement for the usage of the public-domain-version of the system, experience reports of pilot clients and the end user's and developer's documentation. (author) figs., tabs., refs.

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Refer also to citation(s) 20845, 21880, 22538, 22744

21833 (LBST–11/92, pp. 330.1-330.24) **LH_2 Airbus studies.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

The scope of work of the WP covers the 'Assessment of realistic prospects of LH_2-usage in civil aviation', in detail: - Operational scenario for western Europe, - LH_2 cost development, - Investigations on a/c design and cryo systems, - Environmental impact of LH_2-aircraft, - Cost estimate, - The way to a LH_2 fuelled aircraft. (orig.)

21834 (LBST–11/92, pp. 390.1390.15) **Hydrogen fuelled busses for the Brussels district.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

It is of utmost importance that the Brussels district promotes the use of hydrogen as alternate fuel, not only to help clean the city's air but also to help clean the heads of the city's Eurocrats in the Hydrogen Energy Process. The main objective of the present R and D task 'Hydrogen Fuelled Buses for the Brussels District' is to investigate how the Brussels citizens perceive alternatives for their public transport system and to investigate investment, operation and energy costs of an hydrogen bus line based on articulated buses. (orig.)

21835 (LBST–11/92, pp. 400.1-400.17) **System investigation H_2 bus fleet (technology, regulations, future development).** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only); INIS.

In cooperation with Ansaldo Ricerche, ICIL have compiled a technical catalogue, providing the impartial descriptions, both of existing technology and regulations, and the likely future developments of these, as to remedy the first problem faced by a potential hydrogen bus fleet operator viz the absence of an impartial description of the available vehicle and fuels systems together with the absence of a description of regulatory and safety factors which need consideration. (orig.)

21836 (LBST–11/92, pp. 460.1-460.15) **Study on MCH aromatization reforming in non-steady-state conditions.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The problem of running city buses by hydrogen produced on board through MCH aromatization reforming (or dehydrogenation) to toluene involves the study of the related phenomena in non-steady-state conditions, following the continuously and largely variable power request of the combustion engine. The objective of this Supplementary Task has been achieved by formulating adequate computer simulation programs describing the system operating conditions, such as to calculate rapidly and for each assumed condition the mass and heat balances, heat exchange parameters, reaction rates, pressure drops. Three different conceptual models of running the system have been set up and evaluated, with application examples. The more complex one, which includes also the equations describing the performance of a P+I+D control loop, is satisfactory for a practical application. (orig./HW)

21837 (NEI-DK–1533) **Corrosiveness at residues.** Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Miljoe og restprodukter, Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Miljoe og restprodukter. Soerensen, J.L.; Moeller, J. Geoteknisk Inst., Lyngby (Denmark); FORCE Insts., Copenhagen (Denmark); Dansk Teknologisk Inst., Taastrup (Denmark). Plastteknologi; Aalborg Portland (Denmark). Cement- og Betonlaboratoriet. Apr 1994. 137p. (In Danish). Contract ENS-1323/89-4. Order Number DE94771105. Source: OSTI; NTIS.

EFP-89.

Common construction materials have been exposed in drained banquets of residues from flue gas desulphurization processes and fly ash filters in coal fired power stations. The banquet materials were new fly ash, old fly ash, a mixture of fly ash and gypsum, and a mixture of fly ash and calcium sulphite. Concrete and plastics used in pipes, cable isolation and geo-textiles were not affected within a two year period, whereas metals were affected in varying degrees. Copper and austenitic stainless steels did not corrode under any circumstances. Aluminium corroded under strongly alkaline conditions in new fly ash, and steel and nodular cast iron corroded under all conditions. When electrically coupled to similar test specimens buried in gravel the corrosion rate increased in new and old fly ash and the fly ash/gypsum mixture, whereas the corrosion rate in the fly ash/sulphite mixture decreased. Only one surface area ratio was used in the exposures and more or less acceleration of the corrosion rate can be expected, when other ratios are involved. The influence of the area ratios has been examined through inspection of harbour constructions. Large steel exposed behind sheet pilings in fly ash below sea level in contact with smaller areas above sea level in sea sand were both corroded insignificantly. The initial corrosion of steel specimens in the residues were investigated by potentiodynamic polarization mesurements in a test cell designed for the purpose. The recorded polarization curves have given rise to recommendations of specific protection criteria for cathodic protection of steel in new fly ash and in fly ash/sulphite mixture. (au)

21838 (ORNL–6797, pp. C.77-C.84) **Evaporative air conditioning for vehicular applications.** Mattil, J.F. (Climatran Corp., Englewood, CO (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

There are presently three distinct versions of evaporative air conditioning (EAC) technology: (1) direct evaporative cooling (DEC); (2) compound evaporative cooling (CEC); (3) desiccant-assisted evaporative cooling (DAEC). In a direct evaporative cooling system, air cooling occurs as water is evaporated into an air stream as the sensible heat of the air is converted to the latent heat of vaporization. The amount of cooling accomplished is proportionate to the amount of water evaporated. Compound evaporative cooling systems are designed to produce cooler supply air temperature in more humid climates, while adding less humidity to the air stream. This is done by placing a heat exchanger upstream of the DEC module. This heat exchanger produces sensible cooling of the primary air, as heat is transferred to the secondary air stream, which is cooled by direct evaporation. Desiccant-assisted evaporative cooling systems are the final version of EAC technology. DEAC equipment is similar to the CEC system in that air is treated prior to entering the DEC module. In a DEAC system, moisture is actually removed in the first stage, which facilitates improved evaporation and cooling in the DEC module. In addition to the desiccant media and a secondary fan, the system must have a heat source and provisions to regenerate the desiccant material. This report focuses on comfort cooling applications of EAC technology to motor vehicles of different types. To date Climatran's development has been concentrated on transit bus applications, but they have studied additional applications including light rail, trucks, vans, and passenger cars.

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Refer also to citation(s) 20661, 20724, 20924, 21151, 21208, 21230, 21747, 21749, 21808, 21809, 21810, 21811, 21812, 21813, 21814, 21815, 21819, 21820, 21821, 21822, 21823, 21873, 21947, 22041, 22090, 22097, 22166, 22531

21839 (AAA-KTF/IAT–125-A) **A study on the drying process of pigment coated paper webs.** Heikkilae, P. Aabo Akademi, Turku (Finland). Process Design Lab. 1993. 150p. Order Number DE94771056. Source: OSTI; NTIS.

Simulation models have been developed for the drying process of pigment coated webs. Both one-sided and simultaneous double sided coating processes can be simulated. The models have been verified through measurements made on pilot coaters and on full-scale production machines. The model used for describing water drainage rate from the coating color seems to explain satisfactorily the influence of coat weight and temperature. Reduced concentration and/or lower viscosity grade of the soluble binder showed to increase the drainage rate. Sorption isotherms were measured for different pigment coating colors. The coatings showed hygroscopic properties only at very low moisture contents. Binders had more influence on the sorption isotherms than type of pigment. In the simulation model tile coating is approximated as nonhygroscopic material. Very little is known how the drained water is distributed through the thickness of the base stock in different phases of drying. An uniform moisture distribution is assumed here. Heat transfer coefficients for different air flotation dryer nozzles were determined both with a static test bench and trial runs made utilizing pilot coating machines.

21840 (ANL/ES/CP–82644) **Separation and recovery process R&D to enhance automotive materials recycling.** Daniels, E.J. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405133–1: 3. international conference on automobile recycling, Milan (Italy), 5-6 May 1994). Order Number DE94010435. Source: OSTI; NTIS; GPO Dep.

Since 1976, the sales-weighted curb-weight of cars and light trucks sold in the United States has decreased by almost 800 pounds. Vehicle weight reduction has, of course, provided for a significant increase in US fleet fuel economy, from 17 to 27 miles per gallon. However, achievement of the weight reduction and concomitant increase in fuel economy was brought about, in part, by the substitution of lighter-weight materials, such as thinner-gauge coated sheet-steels replacing heavy-gauge noncoated sheet-steels and new aluminum alloys replacing steel as well as the increased use of plastics replacing metals. Each of these new materials has created the need for new technology for materials recycling. This paper highlights some of the R&D being conducted at Argonne National Laboratory to develop technology that will enhance and minimize the cost of automotive materials recycling.

21841 (CONF-9404172–1) **Continuous on-line measurement of lignin concentration in wood pulp.** Jeffers, L.A.; Roman, G.W. Babcock and Wilcox Co., Alliance, OH (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC05-90CE40905. From 16. industrial energy technology conference (IETC); Wickliffe, OH (United States); 14-19 Apr 1994. Order Number DE94013031. Source: OSTI; NTIS; GPO Dep.

We are working toward the development of an instrument for the continuous, on-line measurement of the lignin concentration in wood pulp. The instrument is based on laser induced fluorescence of the wood pulp and is to be used as a primary sensor for both feedback control of the pulping and feedforward control of bleaching. We report here the results of a series of laboratory tests that characterized the fluorescence properties of wood pulp and demonstrated a correlation between various fluorescence functions and the Kappa number of the pulps as determined by TAPPI Procedure T236.

21842 (CONF-9406164–1) **Direct current, closed furnace silicon technology.** Dosaj, V.D. (Dow Corning Corp., Midland, MI (United States)); May, J.B.; Arvidson, A.N. Dow Corning Corp., Midland, MI (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-87ID12624. From Silicon for silicones conference; Loen (Norway); 7-11 Jun 1994. Order Number DE94011795. Source: OSTI; NTIS; GPO Dep.

The dc closed furnace technology for smelting silicon offers technical operating challenges, as well as, economic opportunities for off-gas recovery, reduced electrode consumption, reduced reductant oxidation losses, reduced energy consumption, and improved silicon recovery. The 10 mva dc closed furnace is located in East Selkirk, Manitoba. Construction of this pilot plant was started in September 1990. Following successful commissioning of the furnace in 1992, a number of smelting tests have been conducted aimed at optimization of the furnace operation and the raw material mix. The operation of a closed furnace is significantly different from an open furnace operation. The major difference being in the mechanical movement of the mix, off-gas recovery, and inability to observe the process. These differences made data collection and analysis critical in making operating decisions. This closed furnace was operated by computer control (state of the art in the smelling industry).

21843 (DOE/CE/15993–T1) **Operating data on a novel absorption refrigeration cycle: Progress report.** McCluskey, R.J. (Clarkson Univ., Potsdam, NY (United States). Dept. of Chemical Engineering). Puraq Co., Stamford, CT (United States). 23 Dec 1993. 13p. Sponsored by USDOE, Washington, DC (United States);New York State Energy Research and Development Authority, Albany, NY (United States). DOE Contract FG01-90CE15993. Order Number DE94013168. Source: OSTI; NTIS; GPO Dep.

This report describes the modifications and repairs made to the 200 ton absorption refrigeration pilot plant since April 1992, when Clarkson University assumed responsibility for it. Current operating problems and the performance of the plant, achieved to date, are detailed. Performance has been limited by small air leaks into the absorption section of the plant and by plugging in a heat exchanger which has limited the flow of purified glycol to the absorber. Nonetheless, the plant has been operated for periods of over eight hours with sustained cooling loads of 40 tons. Chilled water has been produced at a temperature as low as 38 degrees Fahrenheit. The principal leak sources have been pinpointed. Plans are described for achieving plant operation at designed levels.

21844 (DOE/CE/40777–T2) **On-machine sensors to measure paper mechanical properties: Final report.** Hall, M.S.; Brodeur, P.H.; Jackson, T.G. Institute of Paper Science and Technology, Atlanta, GA (United States). Oct 1993. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86CE40777. Order Number DE94011578. Source: OSTI; NTIS; GPO Dep.

The measurement of the velocity of ultrasound provides a nondestructive means to characterize the elastic stiffness properties of paper. The objective of this project is to develop sensors capable of measuring the velocity of ultrasound in the thickness and in-plane directions of moving paper webs. On-machine measurements would allow continuous monitoring of product quality as well as provide data for controlling the papermaking process. This final report first reviews the background and various technical approaches explored. Then the preferred configurations and examples of measurements on moving paper webs in the laboratory are presented and discussed. The report concludes with a summary of project results and recommendations for further developments. Transducers mounted in fluid-filled wheels are used to make thickness direction, ZD, ultrasound velocity measurements on paper webs moving in the nip between two such wheels. Comparisons of the arrival times of echo and transmitted pulses with and without the paper web in the nip provide a measure of the transit time and caliper. Bimorph transducers mounted in an aluminum cylinder are used for machine direction (MD) and cross direction (CD) in-plane measurements. These ZD and in-plane sensors are mounted on a web handler in the IPST laboratory.

21845 (DOE/MC/25177–3720) **Evaluation of cement production using a pressurized fluidized-bed combustor.** DeLallo, M.; Eshbach, R. Gilbert/Commonwealth, Inc., Reading, PA (United States). Jan 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC25177. Order Number DE94004108. Source: OSTI; NTIS; GPO Dep.

There are several primary conclusions which can be reached and used to define research required in establishing the feasibility of using PFBC-derived materials as cement feedstock. 1. With appropriate blending almost any material containing the required cement-making materials can be utilized to manufacture cement. However, extensive blending with multiple materials or the use of ash in relatively small quantities would compromise the worth of this concept. 2. The composition of a potential feedstock must be considered not only with respect to the presence of required materials, but just as significantly, with respect to the presence and concentration of known deleterious materials. 3. The processing costs for rendering the feedstock into an acceptable composition and the energy costs associated with both processing and burning must be considered. It should be noted that the cost of energy to produce cement, expressed as a percentage of the price of the product is higher than for any other major industrial product. Energy consumption is, therefore, a major issue. 4. The need for conformance to environmental regulations has a profound effect on the cement industry since waste materials can neither be discharged to the atmosphere or be shipped to a landfill. 5. Fifth, the need for achieving uniformity in the composition of the cement is critical to controlling its quality. Unfortunately, certain materials in very small concentrations have the capability to affect the rate and extent to which the cementitious compound in portland cement are able to form. Particularly critical are variations in the ash, the sulfur content of the coal or the amount and composition of the stack dust returned to the kiln.

21846 (DOE/METC/C–94/7127) **The USDOE Office of Fossil Energy Waste Management Program: An overview.** Harness, J.L. USDOE Morgantown Energy Technology Center, WV (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-940442–2: Conference on the management of high sulfur coal combustion residues, Springfield, IL (United States), 5-7 Apr 1994). Order Number DE94012397. Source: OSTI; NTIS; GPO Dep.

The Department of Energy Office of Fossil Energy Waste Management Program is a small but active program with a focus on management issues for the solid residues produced by advanced coal technologies. The three major project areas are characterization of by-products, disposal management issues, and utilization of by-products. The utilization area can be subdivided into projects looking at land management utilization technologies, management of byproducts in underground mines to address environmental problems, and other utilization technology. As can be seen, there is a focus in the utilization area on utilization technology for large volumes of material. For all project areas, there is an emphasis on cost-shared work which serves as an indicator of private industry and state governments interest in and commitment to commercialization of technologies.

21847 (DOE/PC/92521–T142) **LWA demonstration applications using Illinois coal gasification slag: Phase 2, [Quarterly] technical report, December 1, 1993–February 28, 1994.** Choudhry, V. (Praxis Engineers, Inc., Milpitas, CA (United States)); Steck, P. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012569. Source: OSTI; NTIS; GPO Dep.

The objectives of this program are to demonstrate the feasibility of producing ultra-lightweight aggregates (ULWA) , from solid residues (slag) generated during the gasification of Illinois coals, and to test the products as substitutes for conventional aggregates produced by pyroprocessing of perlite ores. During this reporting period, major accomplishments were the selection of mix designs and test methods for preparation of specimens of expanded slag for testing in precast applications (Task 3) and construction aggregate applications (Task 4). In addition, characterization data (Task 1) were,analyzed, and evaluation of the expanded slag products as substitutes for conventional ULWAs (Task 2) was completed. Potential applications that were identified are: (1) Loose fill insulation; Insulating concrete (roof, floor, and walls); Precast products (blocks and rooftiles). Experimental work during the project is focused on these applications.

21848 (DOE/RL–94-56) **Overview of the government/ industry workshop on opportunities for new materials in pulp and paper processing.** Young, J.K.; Fowler, R.A. Pacific Northwest Lab., Richland, WA (United States). May 1994. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–9743). Order Number DE94013670. Source: OSTI; NTIS; GPO Dep.

This report presents a synopsis of the presentations made at the two-day workshop conducted in Portland, Oregon, on August 12 and 13, 1993, for the Advanced Industrial Concepts division (AICD) of the US Department of Energy (DOE) Office of Industrial Technologies (OIT) and DOE national laboratory representatives from the pulp and paper industry. The information from the presentations is supplemented by additional statistics, as appropriate. The workshop objectives were (1) to develop a strategy and framework for collaboration between the pulp and paper industries and DOE's national laboratories, (2) to identify major challenges to pulp and paper industry modernization, and (3) to identify research objectives for DOE national laboratories to improve materials and process technology in pulp and paper mills. Prior to the workshop, participants had the opportunity to tour paper mills and gain familiarity with pulp and paper processing methods. During the workshop, research needs for materials and processing that were identified at earlier AICD workshops were reviewed. Major problems of the pulp and paper industry were addressed, and ways in which DOE national laboratories are interacting with other industries to foster innovation and solve problems were presented. As a result of this and other workshops, a Pulp Paper Mill of the future strategy is being developed to address challenges identified in these proceedings. Continued efforts are expected by AICD to match candidate materials and processes from DOE national laboratories with the technology needs of pulp and paper mills.

21849 (EDF–93-NM-00024) **Innovation: the induction heated screw.** Paya, B. Electricite de France (EDF), 92 - Clamart (France). Feb 1993. 7p. (In French). Order Number DE94769948. Source: OSTI; NTIS (US Sales Only).

The Research and Development Division at EDF has developed an original technique for heating, drying or baking powder products: the induction heated Archimedes screw. Its main characteristic is simultaneous heating of the screw and the sleeve. (author). 4 figs., 1 tab.

21850 (EDF–93-NM-00031) **Depollution of chemical industry effluents by electrolysis and ionization.** Leclerc, O.; Petit, L. Electricite de France (EDF), 92 - Clamart (France). Oct 1992. 15p. (In French). Order Number DE94769946. Source: OSTI; NTIS (US Sales Only).

Industrial expansion and the ever-increasing use of pollutants can entail major environmental risks. A significant source of such pollution is constituted by dissolved heavy metals, oxidizable organic matter, salts contained in industrial effluents. In response to these problems, EDF is developing low cost processes for the efficient purification of contaminated solutions. Metal can be recovered by electrolysis, for example, thereby preventing the ultimate formation of hydroxide slurry which has to be placed in classified disposal centers. An electro dialysis-electrolysis coupling (also known as electro-electro dialysis) can be used to regenerate the acid and base which have given rise to a saline effluent. The biodegradability of an effluent can be enhanced by ozonization, which can also normalize its COD, bleach it or deodorize it. These methods, which are both adaptable and easy to use, are unquestionably efficient for the treatment of chemical industry effluents. (authors). 10 figs., 2 tabs.

21851 (ENEA-RT-AMB–92-32) **Recovery of metals ions from waters and sludges.** Fabiani, C. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute). ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Oct 1993. 35p. (RT/AMB–92-32). Order Number DE94775329. Source: OSTI; NTIS (US Sales Only).

Due to the growing costs for transportation and land use and to the difficulties in finding new waste disposal sites, research efforts have been directed towards the development of cleaner technologies based on process and product modification for waste minimization to avoid or reduce site remediation costs. In this new

strategy, a very important role will be played by separation chemistry which is essential in industry. Several chemical and physical processes have been already developed for the treatment of waste waters containing metal ions as pollutants, but many of them are not so widely used as would be expected. Advanced separation processes based on ion exchange, absorption, membranes, etc., are considered in this paper for applications in important industrial areas.

21852 (FNAL-TM–1885) **Detecting thrust bearing failure within a screw compressor.** Pallaver, C. Fermi National Accelerator Lab., Batavia, IL (United States). May 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94013419. Source: OSTI; NTIS; INIS; GPO Dep.

A 3 1/2 mile ring of over 1000 superconducting magnets are needed to focus and drive the world's highest energy particle smasher. 24 Refrigerators supply liquid helium to the magnets; 34 high pressure oil flooded screw compressors supply 285 psig helium gas to the refrigerators. The 400 h.p. screws are reliable machines that use 45 gallons of oil per minute to seal and lubricate the rotors, lubricate the bearings, and remove the heat of compression. These machines are spaced out in seven buildings over four miles. A minimum of 28 machines must be operating at all times. A contingent of operators start, stop, and monitor any machine from a distant control room. The 34 compressors have an average of 32,000 hours; 9 machines have over 40,000 hours; the highest is 55,000 hours.

21853 (FRNC-TH–3736) **Contribution to the study of wood thermal treatments until 300 deg C: chemical transformations and physicochemical characterizations.** Avat, F. Ecole Nationale Superieure des Mines, 75 - Paris (France); Ecole Nationale Superieure des Mines, 42 - Saint-Etienne (France). Oct 1993. 339p. (In French). Order Number DE94769950. Source: OSTI; NTIS (US Sales Only).

A wood treated at temperature below 300 deg C and under inert atmosphere is chemically modified without reducing too much its mechanical properties. The topics of this work is to find the optimal conditions for the pyrolysis proceed. The conditions of the manipulation are very important to obtain the final product. Coniferous wood begins to damage about 188 deg C the one of broad-leaved about 195-205 deg C. The microscopic aspect of wood is preserved. In the opposite for a pyrolysis at 250 deg C the crystalline structure of the cellulose is modified especially in the longitudinal-tangential plan. The high carbonylations and condensations which exist at 240 deg C seem to be very interesting. The measure of the colour of the samples can be a fast means to control the treatment proceeding. The pyrolysis wood properties allow new applications for the wood.

21854 (INIS-mf–14223) **Biological treatment in the slurry-reactor with brown-coal products and ceramic materials as biomass carrier: Final report.** Koerner, W. Technische Univ. Bergakademie Freiberg (Germnay). Fachbereich Verfahrenstechnik und Silikattechnik. 20 Oct 1992. 12p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 0319696A. Order Number DE94774230. Source: OSTI; NTIS (US Sales Only); INIS.

In order to raise the decay rate in metabolism processes with low turnover rate, such as microbiological degradations, it is advantageously as well to decouple the residence times of the cells and the culture medium as to increase the cell density with methods of process engineering. For that purpose it is possible to use the three-phase-fluidization where microorganisms are adapted at small, fluidisable and porous solid substances. The gas phase causes a nearly complete radial distribution and a high backmixing. The produced biomass on the carriers with its biocatalytic effect remains in the reactor and the catabolized culture solution drains off. First experiments with a variety of materials have indicated, that Siliziumnitrite can be suitable for such carriers. It is especially wear-resistant, pH-neutral and inexpensive. (orig.). 1 tab., 1 fig.

21855 (LA-UR–94-688) **Selected case studies in modeling and simulation applied to environmentally conscious design and manufacturing.** Lyttle, T.W.; Smith, D.M. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940859–4: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94007556. Source: OSTI; NTIS; GPO Dep.

The Process Modeling System (ProMoS) is an object-oriented, mass balance-based, discrete-event manufacturing simulation framework. Analytical capabilities within ProMoS include complete mass balance specifications and facility profiles for materials consumption, resource utilization and worker exposure. ProMoS software has been utilized in the design of several processing facilities including a Printed Wiring Board (PWB) Manufacturing plant and Department of Energy (DOE) nuclear material processing plants. ProMoS was employed to optimize facility design with respect to production/storage capacity, transportation/shipping constraints, waste generation, cost, worker safety and overall environmental consequences. In addition, ProMoS has been employed in the operational characterization of processing facilities at Los Alamos National Laboratory. The environments used to develop these assessment tools will be discussed in addition to a review of initial implementation results.

21856 (LA-UR–94-1415) **Free displacer and Ringbom displacer for a Malone refrigerator.** Swift, G.W.; Brown, A.O. Los Alamos National Lab., NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940812–1: 29. intersociety energy conversion engineering conference, Monterey, CA (United States), 7-12 Aug 1994). Order Number DE94011697. Source: OSTI; NTIS; GPO Dep.

Malone refrigeration uses a liquid near its critical point (instead of the customary gas) as the working fluid in a Stirling, Brayton, or similar regenerative or recuperative cycle. Thus far, we have focused on the Stirling cycle, to avoid the difficult construction of the high-pressure-difference counterflow recuperator required for a Brayton machine. Our first Malone refrigerator used liquid propylene (C_3H_6) in a double-acting 4-cylinder Stirling configuration. First measurements with a free displacer used in a liquid working fluid are presented. The displacer was operated both in harmonic mode and in Ringbom mode, in liquid carbon dioxide. The results are in reasonable agreement with expectations.

21857 (LBST–11/92, pp. 500.1-500.15) **Investigation on LH_2 co-generation at the Canary Islands.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The WP deals with the co-generation with fuel cell and gas turbine, for the production of electric energy and - more important - potable water by means of either reverse osmosis, or residual energy, or reverse osmosis and multiflash. (orig.)

21858 (NEI-DK–1524) **Energy-efficient model enterprise for the pig slaughter branch: Final report.** Slagteriernes Forskningsinstitut, Roskilde (Denmark); Vestkraft I/S, Esbjerg (Denmark). May 1994. 51p. (In Danish). Contract ENS-51191-91.0094. Order Number DE94771115. Source: OSTI; NTIS.

Carried out at Vestjyske Slagterier, Holstebro, Denmark.

As a result of the work of the Danish government's Committee working on energy conservation within industry, experiments related to giving recommendations on how to save energy were initiated in 10 Danish slaughterhouses. The experiment carried out in the Holstebro department of West Juttish Slaughterhouses (Vestjyske Slagterier), where pigs are slaughtered, is described. All potentials for saving energy were analysed and all the recommendations for modifications were carried out where the repay period was under two years. Although the number of slaughtered animals increased by 27% during the period 1991 - 1993, energy was saved to the degree of 4.35% during 1993 and its use is expected to decrease further throughout 1994. The slaughter house, its production and energy consumption before modification, are described in addition to the experiment itself. The recommendations and the

way they were carried out are exemplified in detail and related key figures are presented. (AB)

21859 (ORNL–6797, pp. C.133-C.150) **Liquid desiccant air conditioners: An attractive alternative to vapor-compression systems.** Lowenstein, A. (AIL Research Inc., Princeton, NJ (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The 1990s are a challenging decade for the HVAC industry. The need for ever more efficient heating, cooling, ventilation and dehumidification technologies is more urgent today than during the "Energy Crisis" of 1970s–energy resources are more depleted and the energy demands of a growing global population continue to increase. However, the development of more efficient HVAC technologies is much more constrained now than it was twenty years ago. CFCs and HCFCs are no longer available. CO_2 emissions should be curtailed as a prudent response to potential global warming. Ventilation rates to buildings must be increased to insure occupants a healthy indoor environment. The relative humidity within a building's HVAC system must be kept sufficiently low to inhibit the growth of microorganisms that can cause disease and other health problems. And, in some parts of the country, electric utilities are having trouble serving their peak air conditioning loads. While it is unlikely that a single cooling and dehumidification technology will emerge as the preferred alternative to today's CFC/HCFC systems in all applications, liquid desiccant air conditioners are unique in their ability to provide high efficiency cooling while addressing all of the proceeding problems. A desiccant air conditioner can be viewed as an indirect evaporative cooler that has been modified to operate at humid outdoor conditions. This enhanced function comes at a price, however - thermal energy must be supplied to the system. Compared to an indirect evaporative cooler, the desiccant air conditioner performs two additional processes: dehumidification of the process air and regeneration of the desiccant. Dehumidification is naturally provided by the desiccant, which be definition is a material that has a high affinity for water vapor. Regeneration is done by heating the desiccant to drive off the water that was absorbed in dehumidifying the process air.

21860 (ORNL–6797, pp. C.197-C.204) **Status of the development of the hydraulic refrigeration system (HRS).** Whitfield, K.L. (Arizona State Univ., Tempe, AZ (United States)); Wood, B.D.; Chau, D.S.C.; Ji, Liang-Jun; Rice, W.; Beakley, G.D. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The hydraulic refrigeration system (HRS) is essentially a synthesis between the hydraulic gas compressor and a vapor compression refrigeration cycle. Devices utilizing hydraulic compression in general, and specifically hydraulic gas compression, have been in existence since antiquity. In these devices, a gas is entrained in a downward liquid flow. The gas is compressed as a consequence of increased hydrostatic head as the gas bubbles move downward. Schulze documented the history of hydraulic air compression and provided performance, construction, and operation data for compressors built between 1896 and 1910. Rice presented a one-dimensional bulk parameter analytical model of hydraulic gas compressors which was used as the foundation for his later work, on the hydraulic refrigeration system. The hydraulic refrigeration system is a vapor compression refrigeration system which uses a vertical liquid loop and a liquid pump to provide circulation of the carrier liquid and compression and condensation of the refrigerant.

21861 (ORNL–6797, pp. C.205-C.210) **Malone refrigeration.** Swift, G.W. (Los Alamos National Lab., NM (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Malone refrigeration is the use of a liquid near its critical point, without evaporation, as working fluid in a regenerative or recuperative refrigeration cycle such as the Stirling and Brayton cycles. It's potential advantages include compactness, efficiency, an environmentally benign working fluid, and reasonable cost. One Malone refrigerator has been built and studied; two more are under construction. Malone refrigeration is such a new, relatively unexplored technology that the potential for inventions leading to improvements in efficiency and simplicity is very high.

21862 (ORNL–6797, pp. C.211-C.214) **Thermoelectric cooling technology.** Mathiprakasam, B. (Midwest Research Institute, Kansas City, MO (United States)). Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

Increased awareness of the impact of chlorofluorocarbons (CFCs) on the global environment has become the impetus in the search for alternative cooling technologies and alternative refrigerants for the vapor compression technology. The cooling industry is concerned that the alternative refrigerants currently under development could still face some tough regulations in the future. Therefore, the industry is looking for alternative cooling technologies that do not apply the vapor compression cycle. There are a number of cooling technologies that are alternatives to the vapor compression technology. One of them is known as Thermoelectric (TE) technology. This paper describes the various aspects of this technology.

21863 (ORNL–6797, pp. C.35-C.41) **STM4-120RF as refrigerator for supermarkets.** Meijer, R.J.; Miniatt, E.C. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The search for harmless working media for cooling systems with respect to ozone depletion has led STM to reconsider the Stirling cycle for this purpose. By using the "short block" of the STM4-120 engine and by developing heat exchangers based on new insights in the Stirling cycle, a reliable, high performance machine can be developed in a short time. The Stirling cycle is well known for being efficient, clean and quiet for engine and cryocooling applications. Due to its adiabatic behavior, it is generally considered to be inefficient for small temperature differences between the compression and expansion side. However, STM has discovered ways to improve the efficiency considerably. The prediction of performance of the new refrigerator, designated the STM4-120RF, now being fabricated, will be given and can be compared with the results of existing vapor compressor units. The cold production of the STM4-120RF does not depend heavily on the temperature ratio between the ambient and the "cold temperature" as the vapor compression system does, and could therefore have a yearly economic advantage over the vapor compressor system.

21864 (ORNL–6797, pp. C.43-C.50) **Acoustic compressors.** Lucas, T. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

As the name implies, an acoustic compressor is in fact a compressor and does not comprise a thermodynamic cycle in and of itself. These compressors are being designed as drop-in replacements for the positive displacement (PD) compressors used in standard vapor-compression systems. Like PD compressors, acoustic compressors create an internal pressure cycle which is converted into an external pressure lift and mass flow via a set of suction and discharge valves. However, the similarity to a PD compressor ends there. Unlike PD compressors, which create their internal pressure cycle with a changing mechanical volume (i.e.

pistons, rotaries, scrolls, etc.), the internal pressure cycle of an acoustic compressor is created by a resonant acoustic wave. As such, acoustic compressions take place within a constant volume chamber, thereby eliminating any frictionally moving parts that require lubrication. Sonic Compressor Systems, Inc. has recently developed the core technology which now makes acoustic compressors possible. In its essence, this core technology is the ability to selectively control the wave shape of extremely high amplitude resonant acoustic waves. This control is provided through resonator geometries that cause the unwanted higher harmonics to be self-canceling. When present, these harmonics add to form shock waves. When the harmonics are canceled, shock waves are eliminated. A recent acoustic compressor prototype has provided pressure lifts in excess of 200 psi and mass flow rates of 0.1-0.2 lbs/min. Prototypes are now being designed for testing at the standard check point (SCP) conditions used for U.S. home refrigerator compressors.

21865 (ORNL–6797, pp. C.51-C.58) **Thermoacoustic refrigeration.** Garrett, S.L. (Naval Postgraduate School, Monterey, CA (United States)); Hofler, T.J.; Perkins, D.K. Oak Ridge National Lab., TN (United States). [1993]. (CONF-9306166–: Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop, Breckenridge, CO (United States), 23-25 Jun 1993). In *Refrigeration and air-conditioning technology workshop.* 274p. Order Number DE94010813. Source: OSTI; NTIS.

The thermoacoustic heat pumping cycle is the youngest technology that will be presented at this workshop. The recognition that useful amounts of heat could be pumped against a substantial temperature gradient with a coefficient-of-performance which is a significant fraction of the Carnot limit was only made ten years ago, with the first demonstration, including efficiency measurements, being made in 1986. This discovery was made even more significant by the recognition that the thermoacoustic heat pumping cycle was intrinsically irreversible. Traditional heat engine cycles, such as the Carnot Cycle typically studied in elementary thermodynamics courses, assume that the individual steps in the cycle are reversible. In thermoacoustic engines, the irreversibility due to the imperfect (diffusive) thermal contact between the acoustically oscillating working fluid and a stationary second thermodynamic medium (the stack) provides the required phasing. This "natural phasing" has produced heat engines which require no moving parts other than the self-maintained oscillations of the working fluid. During this relatively short period, several refrigerators and prime movers have been fabricated and tested at Los Alamos National Laboratories and two refrigerators for spacecraft applications were built at the Naval Postgraduate School. The ThermoAcoustic Life Sciences Refrigerator (TALSR) was designed to pump 700 Btu/hr in the refrigerator mode (+4°C) and 400 Btu/hr in the freezer mode (−22°C). This makes it the first thermoacoustic refrigerator which would be capable of operation as a conventional domestic food refrigerator/freezer. At the present time, there are several preliminary designs which should be capable of one-half ton to three tons of air conditioning capacity, but no prototypes are currently under construction.

21866 (ORNL/TM–12695) **Detection and location of mechanical system degradation by using detector signal noise data.** Damiano, B.; Blakeman, E.D.; Phillips, L.D. Oak Ridge National Lab., TN (United States). Jun 1994. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013404. Source: OSTI; NTIS; GPO Dep.

This report describes the investigation of a diagnostic method for detecting and locating the source of structural degradation in mechanical systems. The goal of this investigation was to determine whether the diagnostic method would be practically and successfully applied to detect and locate structural changes in a mechanical system. The diagnostic method uses a mathematical model of the mechanical system to define relationships between system parameters, such as spring rates and damping rates, and measurable spectral features, such as natural frequencies and mode shapes. These model-defined relationships are incorporated into a neural network, which is used to relate measured spectral features to system parameters. The diagnosis of the system's condition is performed by presenting the neural network with measured spectral features and comparing the system parameters estimated by the neural network to previously estimated values. Changes in the estimated system parameters indicate the location and severity of degradation in the mechanical system. The investigation involved applying the method by using computer-simulated data and data collected from a bench-top mechanical system. The effects of neural network training set size and composition on the accuracy of the model parameter estimates were investigated by using computer-simulated data. The measured data were used to demonstrate that the method can be applied to estimate the parameters of a "real" mechanical system. The results show that this diagnostic method can be applied to successfully locate and estimate the magnitude of structural changes in a mechanical system. The average error in the estimated spring rate values of the bench-top mechanical system was approximately 5 to 10%. This degree of accuracy is sufficient to permit the use of this method for detecting and locating structural degradation in mechanical systems.

21867 (ORNL/TM–12730) **Design and construction of the astronautics refrigerator magnet.** Dresner, L. Oak Ridge National Lab., TN (United States). May 1994. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013599. Source: OSTI; NTIS; GPO Dep.

This document reports on the design, construction, and testing of a 7-Tesla, 4-in. bore superconducting magnet for use in the Astronautics Refrigerator Experiment. The magnet is a single-strand, layer-wound, potted solenoid wound with Formvar-insulated SSC strands. The magnet was constructed by American Magnetics, Inc. of Oak Ridge and has been installed in the Astronautics Refrigerator Experiment at the Astronautics Technology Center in Madison, Wisconsin.

21868 (PNL–9057) **Impact evaluation of an induction furnace replacement under the Energy Savings Plan at Mackenzie Specialty Castings, Incorporated.** Oens, M.A.; Spanner, G.E. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013714. Source: OSTI; NTIS; GPO Dep.

This impact evaluation of an induction furnace replacement that was recently installed at Mackenzie Specialty Castings, Incorporated (Mackenzie Castings) was conducted for the Bonneville Power Administration (Bonneville) as part of an evaluation of its Energy Savings Plan (ESP) Program. The project consists of replacing old power supplies and induction furnace with new, more efficient supplies and equipment. The objective of this impact evaluation was to assess how much electrical energy is being saved at Mackenzie Castings as a result of the ESP and to determine how much the savings cost Bonneville and the region. The impact of the project was evaluated with a combination of engineering analysis, financial analysis, interviews, and submittal reviews (Mackenzie Castings's proposal and completion report). Based on this impact evaluation, energy savings from this project are expected to be 425,257 kWh/yr at minimum annual production, 647,037 kWh/yr at typical annual production, and 1,294,074 kWh/yr at maximum annual production, or 0.05, 0.07, and 0.15 average megawatts, respectively. On a per-ton basis, this project will save 608 kWh/ton or 31% at minimum production and 431 kWh/ton or 39% at typical and maximum production. The project cost $277,110 to install, and Mackenzie Castings received payment of $102,551 (in 1993 dollars) from Bonneville for acquisition of the energy savings. The real levelized cost of these energy savings to Bonneville is 22.9 mills/kWh at minimum production, 15.1 mills/kWh typical production, and 7.5 mills/kWh at maximum production (in 1993 dollars) over the project's assumed 15-year life. The real levelized cost to the region is 59.1 mills/kWh at minimum production, 38.8 mills/kWh at typical production, and 19.4 mills/kWh at maximum production in 1993 dollars, not including transmission and distribution effects.

21869 (PNL–9740) **Electrically enhanced fluidized bed heat exchanger.** Lessor, D.L.; Robertus, R.J.; Roberts, G.L. Pacific Northwest Lab., Richland, WA (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC06-76RL01830. Order Number DE94012989. Source: OSTI; NTIS; GPO Dep.

The experiments have shown that a high level of electrical charging can be achieved in a fluidized bed of two resistive particle types; that bed stabilization rather than increased sensible heat transport dominates low frequency electric field effects on heat transfer with most bed loadings; and, hence, that applying an oscillatory potential difference between tubes or rods in a fluidized bed of two mutual contact-charging particle species gives reduced rather than improved heat transfer. Applying an oscillatory potential difference between rods in a bed of quartz particles fluidized alone did give improved heat transfer, however. With no electric field applied, most fluidized mixes were found to give higher heat transfer rates than the average of the values when each of the two species was fluidized alone. The high level of charging observed in some mixed beds may prove of interest for some air cleanup applications; the results show that simultaneous fluidization of pairs of bipolar charging materials of similar particle size is possible without excessive agglomeration. This would be important for air cleanup.

21870 (TYOT-JULK–330) **Labour, machinery and energy data bases in plant production.** Palonen, J.; Oksanen, E.H. (eds.). Work Efficiency Inst., Helsinki (Finland). 1993. 106p. Order Number DE94771082. Source: OSTI; NTIS.

Material for this study was delivered by the FAO Working Group on Labour, Machinery and Energy Data Bases in Plant Production. The Working Group had participants from seven European countries and it operated in 1989-1992. National data from each country was collected concerning plant production technologies and work study methods. Plant production technologies and selected field operations were compared between the countries. The comparison parameters were labour usage (h/ha), labour costs (ECU/ha), fuel consumption (l/ha), fuel costs (ECU/ha), machine costs (ECU/ha) and total operating costs (ECU/ha). Each country provided the data of eight different crops: spring barley, winter wheat, sugarbeets, potato for human consumption and four other plants typical for each country. The data was compiled and analysed and the publication, written by the staff of Work Efficiency Institute. Different ways of doing work study measurements and calculations in each country created some variation to the results. To correct the variation the labour usage results were recalculated with Dutch computer program, but it did not help. Because of this one must be careful when drawing conclusions about the results. When comparing the different countries the benefits of large scale production and good growing conditions become evident in Hungary, where the amount of inputs included in this study per ton of product is low. In Finland the short growing season limits the yield and the farms are small. Therefore amount of inputs per ton of product is high.

21871 (UCRL-JC–115978) **The development of the chemical exchange warehouse at Lawrence Livermore National Laboratory.** Souza, L.M.; Patterson, C.E. Lawrence Livermore National Lab., CA (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940578–4: Pollution prevention conference, Denver, CO (United States), 3-5 May 1994). Order Number DE94011763. Source: OSTI; NTIS; GPO Dep.

The Chemical Exchange Warehouse (CHEW) at Lawrence Livermore National Laboratory (LLNL) provides an innovative and successful program for storing excess usable chemicals and offering them to others who wig use them productively rather than disposing of them as hazardous waste. Developed by the Laboratory's Hazardous Waste Management (HWM) Division, this waste minimization program provides a system for collecting, identifying, storing, and exchanging chemicals. The chemical inventory in CHEW is displayed in a user-friendly database accessible through a file server and easily available to the Laboratory population. To date the CHEW program has collected over 1,900 items. Since its implementation, 409 items have been redistributed to Laboratory personnel resulting in a cost savings in excess of $50,000.

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Refer also to citation(s) 21150, 21742

21872 (DOE/CE/26617–T1) **District cooling engineering & design program: Final technical report.** Phoenix Dept. of Public Works, AZ (United States). Energy/Facilities Management Div. Mar 1994. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-91CE26617. Order Number DE94013155. Source: OSTI; NTIS; GPO Dep.

Phoenix, Arizona is located in the Sonoran desert. Daytime temperatures typically rise to over 100 F during the three summer months. Average and peak temperatures have tended to rise over recent decades. This is generally attributed to what is known as the heat island effect, due to an increase in heat absorbing concrete and a decrease in irrigated farmland in the area. Phoenix is the eighth largest city in the US with a population of just over one million (1,000,000). The metropolitan area is one of the fastest growing in the nation. Over the last ten years its population has increased by over 40%. It is not an exaggeration to say the general availability of refrigerated air conditioning, both for buildings and automobiles has been an important factor enabling growth. The cost of operating public buildings has risen significantly in the last decade. In fiscal year 92/93 the City of Phoenix had energy expenses of over thirty four million dollars ($34,000,000). Because the City was planning a major new construction project, a new high-rise City Hall, it was decided to study and then optimize the design and selection of building systems to minimize long term owning and operating costs. The City Hall was to be constructed in downtown Phoenix. Phoenix presently owns other buildings in the area. A number of large cooling systems serving groups of buildings are currently operating in the Phoenix area. The City requested that the design consultants analyze the available options and present recommendations to the City's engineering staff.

21873 (DOE/SF/16343–T1) **Provision of utility support services to the US Department of Energy San Francisco Operations Office: Final technical report.** Exeter Associates, Inc., Silver Spring, MD (United States). Apr 1994. 527p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16343. Order Number DE94012165. Source: OSTI; NTIS; GPO Dep.

The main purpose of this project was to provide to DOE/SAN continuing, follow-up support to realize savings from a number of alternate supply arrangements that had already been and/or were expected to be identified under the original project. This expected continuation of these efforts is demonstrated by certain of the tasks that are spelled out in the Statement of Work. For example: Evaluate and propose alternative options and methods for improving efficiency, reducing cost, and making effective use of the energy supplies and facilities under various conditions of use; Provide engineering and economic analysis and recommendations for utility-related facilities and service issues, such as high voltage discounts, ownership of facilities, etc.; Assist in developing strategy and documentation in support of negotiating utility contracts and modifications thereto. In addition, the follow-on contract provided for monitoring and intervening in rate cases that had particular relevance to the DOE/SAN laboratories.

21874 (EDF–93-NM-00029) **EDF and the high-temperature processing of waste.** Franza, L.; Meunier, R.; Pasquini, P. Electricite de France (EDF), 92 - Clamart (France). Apr 1993. 15p. (In French). Order Number DE94769947. Source: OSTI; NTIS (US Sales Only).

Waste are increasing so much that countries are planning and enforcing measures against this waste problem. Waste reduction, recycling, incineration heat recovery are studied and developed. Electricity of France is working on the subject and proposes one solution to reduce and recycle waste: high temperature incineration. (authors). 2 figs., 1 tab.

21875 (IVL-B–1128) **Recycling of paper packagings: material recycling or energy recovery? An environmental study based on five real cases.** Finnveden, G.; Steen, B.; Sundqvist, J.O. Swedish Environmental Research Inst., Stockholm (Sweden). Jan 1994. 163p. (In Swedish). Order Number DE94771023. Source: OSTI; NTIS.

In this study we have made a comparison of material recycling and energy recovery of paper packaging wastes, regarding natural resource consumption, environmental impact and costs. We have

used methodology for life cycle assessment for goal definition inventory, classification and valuation. We have studied systems with three functional units: disposal of waste paper by material recycling or by energy recovery, production of new paper of pulp, and production of energy. In the comparison between material recycling and energy recovery, it has not been possible to draw any general conclusions concerning which alternative is preferable when environmental impact and resource consumption are considered. The result is to a great extent depending on which alternative fuels that compete with paper as energy source: * if biofuels or industrial waste compete with paper, material recycling is favoured. * if oil competes with paper, energy recovery is favoured. The comparison is also affected by how the electricity is produced and evaluated. We have evaluated 'average electricity' which is produced by the average mix of water power, nuclear power, and different fuels, and 'marginal electricity' which is produced by imported coal condense power. The 'marginal electricity' favours material recycling. There is a typical tendency that materials recycling, relatively energy recovery, causes a decrease in electricity consumption and biomass consumption and an increase in oil consumption. The environmental impacts from collection and transportation of paper wastes is of limited significance compared to environmental impacts from pulp and paper production in incineration, regarding the studied parameters. However, methane emissions from landfills can be of significance. The costs for material recycling is higher than the costs for energy recovery in nearly all scenarios, to a great part depending on the costs for collection and transportation. 94 refs, 26 figs, 53 tabs

21876 (NEI-DK–1481) **Mechanical properties of polyurethane cellular plastics in preinsulated pipes.** Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Fjernvarme og produktion af el og varme, Energiministeriets Forskningsudvalg for produktion og fordeling af el og varme. Fjernvarme og produktion af el og varme. Amby, L. (Center for Fjernvarmeteknologi, DTI (Denmark)). Dansk Teknologisk Inst., Taastrup (Denmark). Plastteknologi. Oct 1993. 84p. (In Danish). Contract ENS-1323/92-0015. Order Number DE94771152. Source: OSTI; NTIS.

EFP-92.

As the result of the project implemented in 1992-93, a testing method for determination of radial creeping in polyurethane plastics in preinsulated district heating pipes is proposed. Measurements are carried out on a cut removed from the pipe with the dimensions 60.3/125 mm. The length of the jacket pipe and cellular plastics is 100 mm. The jacket pipe and the cellular plastics are to be cut off at right angles to the axis of symmetry of the medium pipe. Both open terminal surfaces of the insulation are insulated against loss of heat to the surroundings, in order that a uniform spreading of temperature in the whole length of the specimen is maintained. The measurement is carried out by measuring between the point in the middle of the area, where the load is applied, and the two points, where the medium pipe is secured. The measurement lasts 1000 hours. The measurement is carried out just before and after applying the load. The first measurement is carried out after approx. three hours, the fourth and fifth measurements take place the next day. The remaining measurements are carried out once weekly. The load of 0.25 MPa is calculated as the applied power spread over the projected area. The load is applied with a constant velocity within at least 10 seconds. The load is applied at the declaration temperature. The specimens are heated to the loading temperature within a maximum of 30 minutes and then left unloaded for 30 minutes. After that the load is applied immediately. At each temperature three specimens are tested. The testing takes place in atmospherical air at standard laboratory conditions. The radial creeping as a function of time and as a simple mean value of the three measurements is plotted into a double logarithmic system. The plot is extended till 262,980 hours (30 years). Here the absolute creeping is read. This creeping is the result of the test. (EG)

21877 (NEI-DK–1504) **Preliminary design of a combined heat-power plant.** Schade, J.R.; Schade, J. Bioraf Denmark Foundation, Aakirkeby (Denmark). Mar 1994. 112p. (In Danish). Contract ENS-51161-93.0039. Order Number DE94771127. Source: OSTI; NTIS.

The concept of a biorefinery being presently developed is intended for minor local processing plants, manufacturing products based on local agricultural crops, able to compete with petroleum-based products. Optimal utilization of synergy effects and byproducts would increase production efficiency, hence this preliminary project is to find the most suitable heat-power plant concept, based on residue products of Bioraf process and other biofuels. This plant is presumed to be an integrated part in future biorefineries and have a heat effect about 1-10 MV. The optimum size of a combined heat-power plant connected with Aarkirkeby (Bornholm) biorefinery should be determined in this preliminary project, two variants: 3 MW and 8 MW are proposed. The 'two-step process' developed by the Laboratory for Energy Technology (DTU) has been proven to be the most appropriate technology, but economically a plant this size would have to be subsidized, however it could be used as a demonstration project. (EG) (22 refs.)

21878 (NEI-FI–226) **Analysis of Nordic district heating research work 1985-1992.** Nuorkivi, A. Helsinki Univ. of Technology, Otaniemi (Finland). 1992. 145p. Order Number DE94771073. Source: OSTI; NTIS.

Nordiska Ministerraadets Fjaerrvaermeforskningsprogram.

The present analysis has been prepared in order to find out the detailed contribution of the ongoing district heating research and development work, which has been sponsored by the Nordic Council of Ministers during 1985-1992. Most of the individual studies have been carried out by the researchers of the universities and of the research institutes in Denmark, Finland, Iceland, Norway and Sweden. The report starts with the discussion of the behaviour of the heat consumer, i.e. the heat load, which has been discussed ex- and including the distribution network in Chapters 1 and 2 respectively. The heat load sets the technical and economic requirements on the distribution network and the supply plants. The discussion continues with evaluation of the requirements concerning the DH subsystems such as heat generation capacity, construction of network, water treatment, heat exchangers, metering and regulating facilities and entire substations (Chapters 3-7). Further the dynamics of the DH system will be described (Chapters 8, 9, 11) covering pressure and water flow dynamics, water temperature dynamics and fast pressure hammers. The Chapter 10 concentrates on optimization of DH system operation. The Chapters 12 and 14 evaluate some specific or new types of DH, namely pulsatory heat transmission and geothermal heat as a heat source. The Chapter 13 introduces a new method for description of DH system operation planning, namely neural networks and fuzzy system. The contribution of the Nordic research work is compared in Chapter 15 with the European and the American contributions, which have been presented in seminars and studies sponsored by the Nordic Council of Ministers.

21879 (NREL/TP–430-6735) **Prototype demonstration of dual sorbent injection for acid gas control on municipal solid waste combustion units.** National Renewable Energy Lab., Golden, CO (United States); Massachusetts Refusetech, Inc., Hampton, NH (United States). May 1994. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006924. Source: OSTI; NTIS; GPO Dep.

This report gathered and evaluated emissions and operations data associated with furnace injection of dry hydrated lime and duct injection of dry sodium bicarbonate at a commercial, 1500 ton per day, waste-to-energy facility. The information compiled during the project sheds light on these sorbents to affect acid gas emissions from municipal solid waste combustors. The information assesses the capability of these systems to meet the 1990 Clean Air Act and 1991 EPA Emission Guidelines.

21880 (ORNL/CON–352) **Financial comparison of time-of-use pricing with technical DSM programs and generating plants as electric-utility resource options.** Hill, L.J. Oak Ridge National Lab., TN (United States). Apr 1994. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012722. Source: OSTI; NTIS; GPO Dep.

Changing electricity prices to more closely reflect production costs has a significant impact on the consumption of electricity. It

is known, for example, that most of the efficiency gains in the electric power sectors of the industrialized world since the first international oil price shock in 1973 are attributable to the rising trend of electricity prices. This was due to the rising average price of electricity. Because of the unique characteristics of producing electricity, its marginal cost is higher than its average cost during many hours of the day. This study shows that, for utilities not reflecting these cost differences in their rates, there is ample room to satisfy a portion of their resource needs by exploiting the load-shaping properties of time-of-use (TOU) rates. Satisfying a portion of resource requirements by implementing a TOU-pricing program, however, is not costless. Metering and administering TOU pricing requires a financial commitment by an electric utility. And the commitment has an opportunity cost. That is, the funds could be used to construct generating plants or run DSM programs (other than a TOU-pricing program) and satisfy the same resource needs that TOU pricing does. The question addressed in this study is whether a utility is better-served financially by (i) implementing TOU pricing or (ii) running technical DSM programs and building power plants. The answer is that TOU pricing compares favorably on a financial basis with other resources under a wide set of conditions that real-world utilities confront.

21881 (PNL–8756-Vol.1) **Patrick Air Force Base integrated resource assessment: Volume 1, Executive summary.** Sandusky, W.F.; Wahlstrom, R.R. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94011139. Source: OSTI; NTIS; GPO Dep.

Some of the most difficult problems encountered at federal sites in reducing energy consumption in a cost-effective manner revolve around understanding where energy is being used and what technologies can be employed to decrease energy use. Many large federal sites have one or two meters to track electric energy use for several thousand buildings and numerous industrial processes. Even where meters are available on individual buildings or family housing units, the meters are not consistently read. When the federal energy manager has been able to identify high energy users, the energy manager may not have the background, training, or resources to determine the most cost-effective options for reducing this energy use. This limitation can lead to selection of suboptimal projects that prevent the site from achieving full life-cycle cost savings. The USDOE Federal Energy Management Program has been tasked by the US Air Force Space Command to identify, evaluate, and acquire all cost-effective energy projects at selected federal facilities. This is part of a model program developed to provide a systematic approach to evaluating energy opportunities. The program (1) identifies the building groups and end uses using the most energy (not just having the greatest energy-use intensity) and (2) evaluates the numerous options for retrofit or installation of new technology that will result in the selection of the most cost-effective technologies. This model program provides the federal energy manager with a road map to significantly reduce energy use in a planned, rational, cost-effective fashion that is not biased by the constraints of the typical funding sources available to federal sites. The results from this assessment process can easily be turned into a 5- to 10-year energy management plan.

3209 Education and Public Relations

Refer also to citation(s) 23334

21882 (DOE/ER/75648–1) **Middle school integrated science, mathematics and technology curriculum: Final report, September 30, 1991–December 31, 1993.** Brecher, K. Boston Univ., MA (United States). Mar 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75648. Order Number DE94013174. Source: OSTI; NTIS; GPO Dep.

The Project "Middle School Integrated Science, Mathematics and Technology Curriculum" had two goals: (1) to survey the literature of energy education; and (2) to develop a theme for a possible integrated middle school energy based curriculum. We aimed to respond to the challenge of developing thematic integrated curricula as advocated by the NSTA, AAAS and other organizations analyzing the future of American science and mathematics education. The survey of middle school energy curriculum materials has been completed. A list of the resources surveyed are included in this report. Though many energy based curriculum materials have been produced, none of them appears to be broadly disseminated throughout the country. Some energy based curriculum materials are far less well developed than others. We found that an integrated set of modular materials concerning the energy based theme of light and optics does not now exist. If they were developed, they could be broadly disseminated throughout middle school courses in the physical and biological sciences, as well as in new integrated science courses proposed as part of the current science education reform movement. These types of modular materials could also provide a powerful means of student exploration of new technologies such as microcomputers.

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 21171, 21173, 21856, 21896

21883 (ANL/ESD/TM–64) **Potential benefits of oxygen-enriched intake air in a vehicle powered by a spark-ignition engine.** Ng, H.K.; Sekar, R.R. Argonne National Lab., IL (United States). Apr 1994. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013452. Source: OSTI; NTIS; GPO Dep.

A production vehicle powered by a spark-ignition engine (3.1-L Chevrolet Lumina, model year 1990) was tested. The test used oxygen-enriched intake air containing 25 and 28% oxygen by volume to determine (1) if the vehicle would run without difficulties and (2) if emissions benefits would result. Standard Federal Test Procedure (FTP) emissions test cycles were run satisfactorily. Test results of catalytic converter-out emissions (emissions out of the converter) showed that both carbon monoxide and hydrocarbons were reduced significantly in all three phases of the emissions test cycle. Test results of engine-out emissions (emissions straight out of the engine, with the converter removed) showed that carbon monoxide was significantly reduced in the cold phase. All emission test results were compared with those for normal air (21% oxygen). The catalytic converter also had an improved carbon monoxide conversion efficiency under the oxygen-enriched-air conditions. Detailed results of hydrocarbon speciation indicated large reductions in 1,3-butadiene, formaldehyde, acetaldehyde, and benzene from the engine with the oxygen-enriched air. Catalytic converter-out ozone was reduced by 60% with 25%-oxygen-content air. Although NO_x emissions increased significantly, both for engine-out and catalytic converter-out emissions, we anticipate that they can be ameliorated in the near future with new control technologies. The automotive industry currently is developing exhaust-gas control technologies for an oxidizing environment; these technologies should reduce NO_x emissions more efficiently in vehicles that use oxygen-enriched intake air. On the basis of estimates made from current data, several production vehicles that had low NO_x emissions could meet the 2004 Tier II emissions standards with 25%-oxygen-content air.

21884 (DOE/AL/42881–T1) **Infrared measurements of soot formation and droplet sizes in diesel sprays: Final report, June 6, 1987–December 31, 1990.** Parker, T.E.; Morency, J.R.; Foutter, R.R.; Rawlins, W.T. Physical Sciences, Inc., Andover, MA (United States). Jul 1992. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-87AL42881. (PSI–1040/TR-1207). Order Number DE94012308. Source: OSTI; NTIS; GPO Dep.

This report describes an investigation of diesel sprays using a combination of infrared wavelength optical diagnostics to probe the high droplet number density region surrounding the injector tip. Infrared wavelengths were shown to be more effective than visible or ultraviolet wavelength light at penetrating this region of the spray. This success is easily explained by the decrease in optical cross section of small diameter drops (less than 10 μm) for a wavelength shift from the visible to wavelengths near 10 μm. Two types of diagnostics were implemented. First, a custom manufactured, high

speed infrared spectrometer was used to monitor the spectral region between 6 and 12 μm in 0.5 μm intervals. Spectra from this instrument, for specific locations in the combusting spray were used to monitor the development of soot in the spray. The second diagnostic technique used three collinear laser beams focussed into a 0.25 mm beam to monitor the droplet size in the spray. This measurement uses a ratio of signals to remove the droplet number density as a variable and the observed signal ratio is a direct indication of the average (using an approximate radius to the fourth power weighting function) droplet size. The experiments were performed using a shock tube to simulate the conditions typical of diesel combustion (700 to 900 K in temperature and approximately 3.0 MPa in pressure) and a custom manufactured single shot fuel injection system. Optical access in the shock tube included visible and infrared transmissive windows arranged to provide orthogonal access in two directions and perpendicular to the spray axis. The fuel injection system for this work was configured to produce approximately 20 MPa of injection pressure and produced a single injection approximately 2 ms after the injection trigger. This system could therefore be controlled to inject into the quiescent reflected region of the shock tube after the incident shock reflection from the end wall.

21885 (DOE/MC/23166–3711) **Advanced coal-fueled industrial cogeneration gas turbine system: Hot End Simulation Rig.** Galica, M.A. Solar Turbines, Inc., San Diego, CA (United States). Feb 1994. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23166. Order Number DE94004102. Source: OSTI; NTIS; GPO Dep.

This Hot End Simulation Rig (HESR) was an integral part of the overall Solar/METC program chartered to prove the technical, economic, an environmental feasibility of a coal-fueled gas turbine, for cogeneration applications. The program was to culminate in a test of a Solar Centaur Type H engine system operated on coal slurry fuel throughput the engine design operating range. This particular activity was designed to verify the performance of the Centaur Type H engine hot section materials in a coal-fired environment varying the amounts of alkali, ash, and sulfur in the coal to assess the material corrosion. Success in the program was dependent upon the satisfactory resolution of several key issues. Included was the control of hot end corrosion and erosion, necessary to ensure adequate operating life. The Hot End Simulation Rig addressed this important issue by exposing currently used hot section turbine alloys, alternate alloys, and commercially available advanced protective coating systems to a representative coal-fueled environment at turbine inlet temperatures typical of Solar's Centaur Type H. Turbine hot end components which would experience material degradation include the transition duct from the combustor outlet to the turbine inlet, the shroud, nozzles, and blades. A ceramic candle filter vessel was included in the system as the particulate removal device for the HESR. In addition to turbine material testing, the candle material was exposed and evaluated. Long-term testing was intended to sufficiently characterize the performance of these materials for the turbine.

21886 (DOE/MC/23174–3666) **Coal-fueled diesel technology development: Final report, March 3, 1988–January 31, 1994.** GE Transportation Systems, Erie, PA (United States). Jan 1944. 141p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC23174. Order Number DE94004082. Source: OSTI; NTIS; GPO Dep.

Since 1979, the US Department of Energy has been sponsoring Research and Development programs to use coal as a fuel for diesel engines. In 1984, under the partial sponsorship of the Burlington Northern and Norfolk Southern Railroads, GE completed a 30-month study on the economic viability of a coal-fueled locomotive. In response to a GE proposal to continue researching the economic and technical feasibility of a coal-fueled diesel engine for locomotives, DOE awarded a contract to GE Corporate Research and Development for a three-year program that began in March 1985 and was completed in 1988. That program was divided into two parts: an Economic Assessment Study and a Technical Feasibility Study. The Economic Assessment Study evaluated the benefits to be derived from development of a coal-fueled diesel engine. Seven areas and their economic impact on the use of coal-fueled diesels were examined; impact on railroad infrastructure, expected maintenance cost, environmental considerations, impact of higher capital costs, railroad training and crew costs, beneficiated coal costs for viable economics, and future cost of money. The Technical Feasibility Study used laboratory- and bench-scale experiments to investigate the combustion of coal. The major accomplishments of this study were the development of injection hardware for coal water slurry (CWS) fuel, successful testing of CWS fuel in a full-size, single-cylinder, medium-speed diesel engine, evaluation of full-scale engine wear rates with metal and ceramic components, and the characterization of gaseous and particulate emissions. Full combustion of CWS fuel was accomplished at full and part load with reasonable manifold conditions.

21887 (DOE/MC/30246–3718) **Advanced Turbine Systems Program conceptual design and product development: Quarterly report, [August 3, 1993–October 31, 1993].** Karstensen, K.W. Solar Turbines, Inc., San Diego, CA (United States). Feb 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-93MC30246. Order Number DE94004106. Source: OSTI; NTIS; GPO Dep.

This Quarterly Technical Progress Report covers the period August 3 through October 31, 1993, for Phase II of the Advanced Turbine Systems (ATS) Program by Solar Turbines Incorporated under DOE Contract No. DE-AC21-93MC30246. The objective of this program is to provide the conceptual design and product development plan for an industrial gas turbine system to operate at a thermal efficiency of 50 percent and developable to 60 percent. Solar's ATS Engine Design Team reviewed the intercooled and recuperated (ICR) gas turbine concept defined in the Program proposal, validated certain assumptions associated therewith, and began the process of actualizing this concept in terms of achievable turbomachinery components. Given the probable use of a free power turbine arrangement, both 1-spool and 2-spool compressor arrangements were examined with both fixed and variable turbine geometry. Off-design performance, both part-load and full-load over a range of inlet air temperatures, was examined. During this period certain simplifying assumptions were made regarding the amount of cycle air extracted for use in turbine cooling and the distribution of its return to the cycle. The exact influence of turbine cooling air extraction on cycle performance (thermal efficiency) will be highly dependent upon turbine airfoil material selection, its life/temperature capabilities, etc. Thus, cycle performance will be subject to some degree of change as the design progresses. Even now, improvements made to the cycle performance model will result in variation in presented results. As a general rule, later results will always supersede earlier results when there is an apparent conflict.

21888 (LBST–11/92, pp. 310.1-310.11) **$NO_x/H_2O/H_2$ mass spectrometric testing.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

When operating reciprocating spark-ignition engines on hydrogen, the nitric oxide emissions are negligible if the air count is large. However, due to the high peak combustion temperature, emissions of oxides of nitrogen are unusually high in the case of a mixture rich in energy. Those produced at full load will therefore be an important design criterion for developing hydrogen engines in the future. This also applies to engines in city buses, the pollutant emission of which could become inadmissibly high during acceleration phases. Other restricted combustion products such as hydrocarbons and carbon monoxide and also carbon dioxide are only produced from the combustion of lubricating oil and are therefore expected in negligible amounts or in amounts which cannot be detected. A mass spectrometer is being used for the first time on the BMW hydrogen engine test rig for the purposes of analyzing exhaust emissions. (orig./HW)

21889 (NREL/TP–425-6345) **Combustion characterization of methylal in reciprocating engines.** Dodge, L. (Southwest Research Institute, San Antonio, TX (United States)); Naegeli, D. National Renewable Energy Lab., Golden, CO (United States); Midwest Research Inst., Cary, NC (United States). Jun 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006949. Source: OSTI; NTIS; GPO Dep.

Methylal, $CH_3OCH_2OCH_3$, also known as dimethoxy-methane, is unique among oxygenates in that it has a low autoignition temperature, no carbon-carbon bonds, and is soluble in middle distillate fuels. Because of these properties, methylal has been shown to be a favorable fuel additive for reducing smoke in diesel engines. Recent measurements of ignition delay times indicate that methylal has a cetane number in the range of 45-50, which is compatible with diesel fuels. Engine tests have shown that adding methylal to diesel fuel significantly reduces smoke emissions. Gaseous emissions and combustion efficiencies obtained with methylal/diesel fuel blends remain essentially the same as those measured using neat diesel fuel. Lubricity measurements of methylal/diesel fuel blends with a ball on cylinder lubrication evaluator (BOCLE) show that methylal improves the lubricity of diesel fuel. Even though additions of methylal lower the fuel viscosity, the results of the BOCLE tests indicate that the methylal/diesel fuel blends cause less pump wear than neat diesel fuel. The one drawback is that methylal has a low boiling point (42°C) and a relatively high vapor pressure. As a result, it lowers the flash point of diesel fuel and causes a potential fuel tank flammability hazard. One solution to this increased volatility is to make polyoxymethylenes with the general formula of $CH_3O(CH_2O)_xCH_3$ where $x > 2$. The molecules are similar to methylal, but have higher molecular weights and thus higher viscosities and substantially lower vapor pressures. Therefore, their flash points will be compatible with regular diesel fuel. The polyoxymethylenes are expected to have combustion properties similar to methylal. It is theorized that by analogy with hydrocarbons, the ignition quality (i.e., cetane number) of the polyoxymethylenes will be better than that of methylal.

3303 Electric-Powered Systems

Refer also to citation(s) 21206

21890 (ANL/CMT/CP–82684) **Sodium/nickel-chloride battery development.** Redey, L. (Argonne National Lab., IL (United States)); Prakash, J.; Vissers, D.R.; Dowgiallo, E.J. Argonne National Lab., IL (United States). 28 Feb 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9310169–3: 1993 automotive technology development contractors' meeting, Dearborn, MI (United States), 18-21 Oct 1993). Order Number DE94011481. Source: OSTI; NTIS; GPO Dep.

The performance of the $Ni/NiCl_2$ positive electrode for the $Na/NiCl_2$ battery has been significantly improved compared to that of our earlier electrodes, representative for 1990. This improvement has been achieved by lowering the impedance and increasing the usable capacity through the use of chemical additives and a tailored electrode morphology. The improved electrode has excellent performance even at 250°C and can be recharged within one hour. The performance of this new electrode was measured by the conventional interrupted galvanostatic method and under simulated driving profiles. These measurements were used to project the performance of 40- to 60-kWh batteries built with this new electrode combined with the already highly developed sodium/β''-alumina negative electrode. These calculated results yielded a specific power of 150–400 W/kg and a specific energy of 110–200 Wh/kg for batteries with single-tube and bipolar cell designs. This high performance, along with the high cell voltage, mid-temperature operation, fast recharge capability, and short-circuited failure mode of the electrode couple, makes the $Na/NiCl_2$ battery attractive for electric vehicle applications.

21891 (BNL–60468) **SUNRAYCE 95: Working safely with lead-acid batteries and photovoltaic power systems.** DePhillips, M.P. (Brookhaven National Lab., Upton, NY (United States). Biomedical and Environmental Assessment Group); Moskowitz, I.D.; Fthenakis, V.M. Brookhaven National Lab., Upton, NY (United States). 27 May 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013536. Source: OSTI; NTIS; GPO Dep.

This document is a power system and battery safety handbook for participants in the SUNRAYCE 95 solar powered electric vehicle program. The topics of the handbook include batteries, photovoltaic modules, safety equipment needed for working with sulfuric acid electrolyte and batteries, battery transport, accident response, battery recharging and ventilation, electrical risks on-board vehicle, external electrical risks, electrical risk management strategies, and general maintenance including troubleshooting, hydrometer check and voltmeter check.

21892 (CONF-931269–, pp. 21-24) **Proposal of super energy efficient vehicle (SEEV) with photovoltaic cell and other energy recovery systems.** Saito, T. (Tohoku University, Sendai (Japan). Faculty of Engineering); Matsushita, T.; Furukawa, Y. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December 9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

A super energy efficient vehicle (SEEV) was fabricated on a trial basis using existing products and technologies to give considerations on its driving performance by means of test drives and a simulation. The SEEV is an electric vehicle weighing 1400 kg, driven by solar cells, batteries, and motors. The efficiency of the solar cells is 11%, by which 23% of the power consumption can be supplemented by solar energy under a condition of average drive distance of the passenger car of 20 km/day and driving at a constant speed. About 11% of the energy was recovered by use of regenerative brakes in a drive test on a test course. The vehicle's fuel consumption is 11.7 km/l of gasoline against 7.57 km/l in a gasoline-fueled car of the same class when petroleum refining loss is taken into account. The fuel consumption can go up to 14.7 km/l if effects of the solar cells are included. Poor matching because of using a commercially available gasoline-fueled car as the base was improved, and the fuel consumption was calculated by using a simulation program. As a result, it was shown that the fuel consumption can reach 102.4 km/l ultimately. 7 refs., 4 figs., 7 tabs.

21893 (NREL/TP–463-6157) **Fuel savings and emissions reductions from light duty fuel cell vehicles.** Mark, J.; Ohi, J.M.; Hudson, D.V. Jr. National Renewable Energy Lab., Golden, CO (United States). Apr 1994. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006909. Source: OSTI; NTIS; GPO Dep.

Fuel cell vehicles (FCVs) operate efficiently, emit few pollutants, and run on nonpetroleum fuels. Because of these characteristics, the large-scale deployment of FCVs has the potential to lessen US dependence on foreign oil and improve air quality. This study characterizes the benefits of large-scale FCV deployment in the light duty vehicle market. Specifically, the study assesses the potential fuel savings and emissions reductions resulting from large-scale use of these FCVs and identifies the key parameters that affect the scope of the benefits from FCV use. The analysis scenario assumes that FCVs will compete with gasoline-powered light trucks and cars in the new vehicle market for replacement of retired vehicles and will compete for growth in the total market. Analysts concluded that the potential benefits from FCVs, measured in terms of consumer outlays for motor fuel and the value of reduced air emissions, are substantial.

3304 Hybrid Systems

Refer also to citation(s) 21137

3307 Emission Control

Refer also to citation(s) 21833, 21883, 21887, 21888

21894 (LBST–11/92, pp. 320.1-320.10) **NO-reduction in oxygen-containing exhaust gases.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The objective of the task to be performed is, develop a new method to treat exhaust gases of engines which are operated under lean air/fuel conditions. DB 'propose a new technique, called 'ARD-Technique', which, as compared to todays conventional catalytic processes, means a completely new procedure in exhaust gas treatment. This paper reports on laboratory investigations of this new method to reduce nitrogen oxide in the exhaust gases of engines which are operated under lean air/fuel conditions as for instance hydrogen operated engines'. (orig.)

3308 Alternative Fuels

Refer also to citation(s) 21885

21895 (DOE/CH/10093–245) **Addendum: Tenth International Symposium on Alcohol Fuels, The road to commercialization.** National Renewable Energy Lab., Golden, CO (United States). May 1994. 341p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9311211–Add.: 10. international symposium on alcohol fuels, Colorado Springs, CO (United States), 7-10 Nov 1993). Order Number DE93018219. Source: OSTI; NTIS; GPO Dep.

The Tenth International Symposium on ALCOHOL FUELS "THE ROAD TO COMMERCIALIZATION" was held at the Broadmoor Hotel, Colorado Springs, Colorado, USA November 7–10, 1993. Twenty-seven papers on the production of alcohol fuels, specifications, their use in automobiles, buses and trucks, emission control, and government policies were presented. Individual papers have been processed separately for entry into the data base.

21896 (DOE/CH/10093–314) **Comparative alternative/clean fuels provisions of the Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992.** National Renewable Energy Lab., Golden, CO (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006887. Source: OSTI; NTIS; GPO Dep.

This is a summary side-by-side comparison of the fleet provisions and incentives under the Clean Air Act Amendments of 1990 (Public Law 101–549) and the Energy Policy Act of 1992 (Public Law 102–486). For more information on how to comply, contact your regional Department of Energy and Environmental Protection Agency support offices in addition to your state energy office.

21897 (DOE/CH/10093–315) **Alternative fuel information: Facts about CNG and LPG conversion.** O'Connor, K. USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006888. Source: OSTI; NTIS; GPO Dep.

As new environmental and energy related laws begin to take effect, increasing numbers of alternative fuel vehicles (AFVs) will be required in federal, state, municipal, and private fleets across the country. The National Energy Policy Act of 1992 and the Clean Air Act Amendments of 1990, along with several new state and local laws, will require fleet managers to either purchase original equipment manufacturer (OEM) vehicles, which are produced by automakers, or convert existing vehicles to run on alternative fuels. Because there is a limited availability and selection of OEM vehicles, conversions are seen as a transition to the time when automakers will produce more AFVs for public sale. A converted vehicle is any vehicle that originally was designed to operate on gasoline, and has been altered to run on an alternative fuel such as compressed natural gas (CNG) or propane (liquefied petroleum gas – LPG), the two most common types of fuel conversions. In the United States, more than 25,000 vehicles already have been converted to COG, and 300,000 have been converted to LPG.

21898 (DOE/CH/10093–316) **Alternative fuel information: Glossary.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006889. Source: OSTI; NTIS; GPO Dep.

This short document contains definitions of acronyms and definitions of terms used in papers on the use of alternative fuels in automobiles.

21899 (DOE/CH/10093–317) **Alternative fuel information sources.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006890. Source: OSTI; NTIS; GPO Dep.

This short document contains a list of more than 200 US sources of information (Name, address, phone number, and sometimes contact) related to the use of alternative fuels in automobiles and trucks. Electric-powered cars are also included.

21900 (DOE/CH/10093–318) **Alternative fuel information: Alternative fuel vehicle outlook.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006891. Source: OSTI; NTIS; GPO Dep.

Major automobile manufacturers continue to examine a variety of alternative fuel vehicle (AFV) options in an effort to provide vehicles that meet the fleet requirements of the Clean Air Act Amendments of 1990 (CAAA) and the Energy Policy Act of 1992 (EPACT). The current generation of AFVs available to consumers is somewhat limited as the auto industry attempts to respond to the presently uncertain market. At the same time, however, the automobile industry must anticipate future demand and is therefore engaged in research, development, and production programs on a wide range of alternative fuels. The ultimate composition of the AFV fleet may be determined by state and local regulations which will have the effect of determining demand. Many state and regional groups may require vehicles to meet emission standards more stringent than those required by the federal government. Therefore, a significant impact on the market could occur if emission classifications begin serving as the benchmark for vehicles, rather than simply certifying a vehicle as capable of operating on an "alternative" to gasoline. Vehicles classified as Zero-Emissions, or even Inherently Low-Emissions, could most likely be met only by electricity or natural gas, thereby dictating that multi-fuel vehicles would be unable to participate in some clean air markets. In the near-term, the Clinton Administration desires to accelerate the use of alternative fuels as evidenced by an executive order directing the federal government to increase the rate of conversion of the federal fleet beyond that called for in EPACT. The Administration has expressed particular interest in using more compressed natural gas (CNG) as a motor fuel, which has resulted in the auto industry's strong response of concentrating short-term efforts on CNG vehicles. For the 1994 model year, a number of CNG cars and trucks will be available from major automobile manufacturers.

21901 (DOE/CH/10093–319) **Alternative fuel information: State alternative fuel laws and incentives.** USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006892. Source: OSTI; NTIS; GPO Dep.

Laws and incentives related to the use of alternative fuels in automobiles are listed for most states of USA.

21902 (NEI-DK–1535-Rev.) **A domestic gas pump for natural-gas driven cars: Installation, operation and servicing.** Pedersen, P. Dansk Gasteknisk Center A/S, Hoersholm (Denmark). Sep 1993. 38p. (In Danish). Order Number DE94771107. Source: OSTI; NTIS.

A manual giving guidelines for the installation, operation and servicing of a domestic gas pump for natural-gas driven cars. The design of the gas pump in question is not yet authorized in Denmark but permission has been given to set an example up for

testing during a period of two years on condition that the guidelines for installations appearing in this document are followed. Emphasis is laid on safety measures and detailed instructions (illustrated by diagrams) are given on placing, installation, connection to gas and electricity supply, conditions of high pressure, startup, use of the control panel, fault finding and maintenance. (AB)

21903 (NREL/TP–425-6544) **Technical evaluation and assessment of CNG/LPG bi-fuel and flex-fuel vehicle viability.** Sinor, J.E. (Sinor (J.E.) Consultants, Inc., Niwot, CO (United States)). National Renewable Energy Lab., Golden, CO (United States); Sinor (J.E.) Consultants, Inc., Niwot, CO (United States). May 1994. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006925. Source: OSTI; NTIS; GPO Dep.

This report compares vehicles using compressed natural gas (CNG), liquefied petroleum gas (LPG), and combinations of the two in bi-fuel or flex-fuel configurations. Evidence shows that environmental and energy advantages can be gained by replacing two-fuel CNG/gasoline vehicles with two-fuel or flex-fuel systems to be economically competitive, it is necessary to develop a universal CNG/LPG pressure-regulator-injector and engine control module to switch from one tank to the other. For flex-fuel CNG/LPG designs, appropriate composition sensors, refueling pumps, fuel tanks, and vaporizers are necessary.

21904 (SAND–94-8229) **Hydrogen storage for vehicular applications: Technology status and key development areas.** Robinson, S.L.; Handrock, J.L. Sandia National Labs., Livermore, CA (United States). Apr 1994. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011626. Source: OSTI; NTIS; GPO Dep.

The state-of-the-art of hydrogen storage technology is reviewed, including gaseous, liquid, hydride, surface adsorbed media, glass microsphere, chemical reaction, and liquid chemical technologies. The review of each technology includes a discussion of advantages, disadvantages, likelihood of success, and key research and development activities. A preferred technological path for the development of effective near-term hydrogen storage includes both cur-rent DOT qualified and advanced compressed storage for down-sized highly efficient but moderate range vehicles, and liquid storage for fleet vehicle applications. Adsorbate media are also suitable for fleet applications but not for intermittent uses. Volume-optimized transition metal hydride beds are also viable for short range applications. Long-term development of coated nanoparticulate or metal matrix high conductivity magnesium alloy, is recommended. In addition, a room temperature adsorbate medium should be developed to avoid cryogenic storage requirements. Chemical storage and oxidative schemes present serious obstacles which must be addressed for these technologies to have a future role.

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

21905 (SAND–91-8010/2, pp. 9-36) **The pentomic experience.** Gold, T. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The Pentomic experience is presented in outline form. The subject is discussed under the following topics: context, objectives, description, assessment, and lessons. The context included President Eisenhower's "new look" strategy and service rivalry for nuclear share. The objectives for the Pentomic Division included dual capability with nuclear emphasis, strategic mobility, smaller, and major organizational changes. The Pentomic Division is described as a separate division in which the infantry battle group is a basic building block. The Pentomic Division was designed to be dual-capable in both conventional and nuclear warfare and was assessed or perceived to be neither. The possible reasons for the failure of the concept were: problem too hard, wrong solution, premature solution, weak implementation, and overambitious goals.

21906 (SAND–91-8010/2, pp. 37-48) **Project ATTACK and Project VISTA: Benchmark studies on the road to NATO's early TNF policy.** Garrity, P.J. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

This paper is concerned with those studies and analyses that affected early NATO nuclear policy and force structure. The discussion focuses specifically on two "benchmark" activities. Project VISTA and Project ATTACK. These two studies were chosen less because one can document their direct impact on NATO nuclear policy and more because they capture the state of thinking about tactical nuclear weapons at a particular point of time. Project VISTA offers an especially important benchmark in this respect. Project ATTACK is a rather different kind of benchmark. It is not a pathbreaking study. It is much narrower and more technical than VISTA. It appears to have received no public attention. Project ATTACK is interesting because it seems to capture a "nuts-and-bolts" feel for how U.S. (and thereby NATO) theater nuclear policy was evolving prior to MC 48. The background and context for Project VISTA and Project ATTACK are presented and discussed.

21907 (SAND–91-8010/2, pp. 49-66) **Summary of remarks by R.C. Richardson: NATO's basic TNF problem and principal posture findings.** Richardson, R.C. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The use of atomic weapons in NATO defense planning seems to be an issue of special interest to writers and historians. It is also an issue fraught with confusion for the official record of actions taken does not tell the whole story. Both writers and historians seem to be having a hard time getting a clear and agreed position on this subject and for good reasons. Reasons which are not generally understood although important not only to history but also to future U.S. security planning. The confusion over tactical nuclear planning in NATO can be traced to the early 1950s when the Alliance was faced with the need to develop and present a credible defense posture for its European members while being unable to field classic force levels anywhere near comparable to those of the Warsaw Pact nations that threatened them. A summary paper is presented in two parts. Part I explains what the Basic TNF Problem appears to be and how it came about and Part II discusses examples of the type of corrective measures that should have been - and still should be - taken.

21908 (SAND–91-8010/2, pp. 67-114) **Nuclear weapons and NATO operations: Doctrine, studies, and exercises.** Karber, P.A. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

A listing of papers is presented on the doctrine, studies, and exercises dealing with nuclear weapons and NATO operations for the period 1950-1983. The papers deal with studies on massive retaliation, sword and shield, and flexible response. Some of the enduring issues of nuclear weapons in NATO are listed.

21909 (SAND–91-8010/2, pp. 115-136) **The role of studies and analysis in the Berlin crisis.** Schake, K. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis

and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The question posed for this conference was whether military exercises, studies and analysis have made an appreciable difference in the policies associated with tactical nuclear forces (TNF) in the North Atlantic Treaty Organization (NATO). Some of the papers leave the impression that studies, analysis and military exercises have very little impact on the strategy, policy decisions and force posture of NATO tactical nuclear forces. The studies and analyses undertaken during the 1961 Berlin crisis suggest a very different conclusion: that studies and analyses, when specific in scope and carrying some sense of immediacy, can be enormously influential. Whether one considers the changes to be positive or negative, the experience of the 1961 Berlin crisis suggests that studies and analyses had a tangible and direct impact both on contingency planning for the Berlin crisis specifically and on discussions of the role of tactical nuclear forces more broadly. The results of these studies and analyses are discussed.

21910 (SAND–91-8010/2, pp. 137-152) **The sword-shield strategy of the early 1960s.** Steinhoff, J. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The sword and shield strategy of the post WWII German Federal Republic is discussed. The effort to rebuild the German air force following WWII is outlined. This effort was initiated in 1956 with material furnished by the US through the Nash Plan. The debate surrounding the validity of the sword-shield concept is described.

21911 (SAND–91-8010/2, pp. 153-168) **The follow-on use studies.** Brown, G. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

NATO's follow-on use studies for the period 1969-1973 are outlined under the following topics: background, follow-on use study program (phases), transition to nuclear warfare, primary policy documents (phase III), additional sources (phase III), nuclear policy evolution - the decade of the 70's, and NATO TNF Policy - summary questions.

21912 (SAND–91-8010/2, pp. 169-194) **NATO's requirements and policy for LRTNF.** Davis, L.E. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

In a special meeting of Foreign and Defense Ministers, the NATO alliance on 12 December 1979 decided to modernize its long range theater nuclear forces (LRTNF) through the deployment in Europe of 572 Pershing II and ground launched cruise missiles (GLCM). This decision was accompanied by an offer from the US to the U.S.S.R. to negotiate limitations on these LRTNF which would be global, equal, and verifiable. The story of NATO's dual-track decision as well as the INF Treaty is well chronicled. What is missing is a detailed study of the processes within the US government and the NATO alliance by which the LRTNF decisions were made. The role that analysis played, and the lessons that can be drawn for future policies on NATO's theater nuclear forces are discussed.

21913 (SAND–91-8010/2, pp. 195-212) **Development of the follow-on force attack strategy.** Braddock, J.; Starry, D. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The development of the follow-on force attack strategy is outlined. The strategy is discussed under the following topics: relative locations, commitment of second echelon, type front deployment for offensive operation, unique assessment, activities, area for representative front, army, division, resulting improvements, background, essential elements of analysis, developing target processes, relative locations of possible assembly areas analyzed, second echelon queques, and illustration of Soviet concept of operations.

21914 (SAND–91-8010/2, pp. 213-288) **U.S. Theater Nuclear Policy.** Thompson, J.A. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

In the brief period between May 1978 and December 12, 1979, U.S. policy, and the policy of the NATO Alliance, toward theater nuclear forces (TNF) changed dramatically. The consequences of this change now dominate the political agenda in East-West (and West-West) relations. The ultimate outcome of the now renamed intermediate-range nuclear force (INF) debate will have far-reaching consequences for the future of the Atlantic Alliance. How did this issue emerge? Why did the US change its policy? How did it work with its Alliance to change NATO policy? These questions, among others, are now figuring in the debate. The answers to these questions are discussed in detail.

21915 (SAND–91-8010/2, pp. 289-308) **Evolution of Soviet Theater Nuclear Forces.** Atkeson, E.B. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

Soviet theater nuclear forces were a major pillar of Soviet superpower strength, rising sharply under Krushchev in the latter 1950s to their zenith under Brezhnev twenty years later. Most recently they have begun their decline under Gorbachev, and while not yet facing extinction, may be headed for a much reduced role under the new thinking in the USSR. This paper deals with the Soviet TNF in six periods of their life: The Post-war Stalin Period (1945-1953), the Post-Stalin Period (1953-1955), The Transition Period (1955-1959), The Period of Nuclear Revolution (1960-1964), The Period of Modern TNF Planning (1965-1980), and The Period of Non-nuclear Planning (1980-1987).

21916 (SAND–91-8010/2, pp. 309-333) **Concluding remarks: Reflections on the forty year's history of TNF.** Martin, L.W. Sandia National Labs., Livermore, CA (United States). Feb 1994. (CONF-9009546–Vol.2: History of NATO TNF policy: the role of studies, analysis and exercises conference, Livermore, CA (United States), 12-14 Sep 1990). In *The history of NATO TNF policy: The role of studies, analysis and exercises conference proceedings.* 336p. Order Number DE94009227. Source: OSTI; NTIS; INIS.

The History of NATO's TNF policy is much wider than it may first appear, for NATO TNF policy has been the heart of the whole nuclear question since shortly after it was first so dramatically posed in 1945. Admittedly the ultimate foundation of deterrence has been the overarching balance of strategic nuclear weapons between the two Superpowers. These have provided the strategic "monitor" of ultimately unacceptable damage that inspires cautious behavior at lower levels of conflict. But if the strategic weapons inculcate the caution, it has been with TNF that the opposing blocs have chiefly tried to harness nuclear weapons to particular situations and manipulate them to their advantage. The key characteristic of nuclear weapons that distinguishes them from all others is their virtually unlimited destructive potential. Powers disposing of large strategic nuclear forces cannot readily, perhaps ever, be deprived of an ultimate capacity to do outrageous harm. If they are to be defeated, it must therefore be by outmaneuvering them so that they yield the

essential prizes without recourse to their worst possibilities. If nuclear weapons are to be used in this process, whether actually or by latent influence on particular issues, it must be in some limited form. NATO's TNF policy constitutes the best example of this so far in nuclear history.

3502 Proliferation

Refer also to citation(s) 21114, 21115, 21122, 21318, 21380

21917 (UCRL-CR–116951) **National independence and nonproliferation in the new states of Central Asia.** Gleason, G. Lawrence Livermore National Lab., CA (United States). Dec 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012375. Source: OSTI; NTIS; GPO Dep.

Five independent states emerged in Central Asia from the breakup of the USSR. One of these states, Kazakhstan, possesses nuclear weapons. The other four of these states, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, are not known to possess nuclear weapons, however they occupy a geostrategic position which makes them important to non-proliferation efforts. The present report profiles the capabilities and intentions of these four Central Asian states. The analysis of capabilities suggests that none of these states has the capability to develop a usable nuclear weapon. However, all of these countries– especially Uzbekistan– have components of the old Soviet nuclear weapons complex which are now orphans. They have no use for these facilities and must either re-profile them, destroy them, or transfer them. The analysis of intentions suggests that the dynamics of national independence have created a situation in which Uzbekistan has hegemonic designs in the region. Implications for retarding nuclear proliferation in the Central Asian region are examined. Opportunities for outside influence are assessed.

21918 (UCRL-JC–116224) **Deterrence, denuclearization, and proliferation: Alternative visions of the next fifty years.** Lehman, R.F. II. Lawrence Livermore National Lab., CA (United States). 12 Feb 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9310320–1: Joint Indo-US seminar on nonproliferation and technology transfer center for the advanced study of India, Philadelphia, PA (United States), 3-6 Oct 1993). Order Number DE94010901. Source: OSTI; NTIS; INIS; GPO Dep.

The great library of Alexandria may have contained fewer volumes than the number which have been written on the subject of nuclear weapons in the Cold War. With the end of the Cold War, a new nuclear library is in the making. Much thought is being given to the next steps in nuclear policy, strategy, forces, arms control, and nonproliferation. For this very distinguished conference, however, I have been asked to look further ahead indeed, forward fifty-years. Prognostication is always a risky business. Detailed predictions beyond the shortest duration are difficult to label as "scientific" even in the social sciences. Forecasting ahead fifty years in an age of ever accelerating change would seem to be hopeless. Projecting the future of nuclear weapons, however, may not be as complex as one might think. Detailing the future fifty years from now is not necessary. We want to inform upcoming decisions by examining the possibilities, not write a history in advance of what is to happen. Our look forward con benefit from a brief look back fifty years. In retrospect, those years passed quickly, and with each additional year, analysts make them appear more simple than they seemed at the time. This paper contributes further to this process of oversimplification, as we say, "for heuristic purposes." When in doubt, I have erred on the side of being provocative.

21919 (UCRL-LR–114070-4) **Director's series on proliferation.** Bailey, K.C. (ed.). Lawrence Livermore National Lab., CA (United States). 23 May 1994. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-931271–: Conference on nuclear, chemical, biological, and missile proliferation, Livermore, CA (United States), Dec 1993). Order Number DE94012773. Source: OSTI; NTIS; GPO Dep.

Biological weapons can be more horrific and devastating to mankind than nuclear weapons. Diseases perpetrated against an enemy can cause slow, agonizing death of civilians and soldiers alike; they cannot be limited in their effects only to the site of battlefield use, or to the day on which they are used. Indeed, long-lasting consequences may include mutations of the virus or bacteria into a more lethal form. It may also spread well beyond the intended victims to other populations. Biological agents are relatively easy and inexpensive to make. A biological agent can be produced in a laboratory costing only thousands of dollars. Time required, too, is less for biological weapons. Agent can be produced in days or weeks and weaponized with off-the-shelf technology. Making matters worse, biological weapons can be manufactured in small facilities that are impossible to detect with today's technology. Given that biological agents cannot be disinvented, the best hope is to convince countries to forego such weaponry. The Biological and Toxin Weapons Convention of 1972 outlaws the possession and use of such weapons. But this treaty, like all others, offers no guarantees, even if countries sign it. Developing the means to detect and defend against such weapons makes them less effective, and therefore less attractive to a user. This issue focuses on several aspects of the biological weapons problem: the history and current status of the biological weapons threat, and the US response to that threat; technologies for detecting and defending against biological agents; and obstacles to seeking additional arms or export control measures.

3503 Verification

Refer also to citation(s) 21389, 22465, 22466, 23317

21920 (ANL/ACTV–93/3) **Whither plutonium? Demilitarization and disposal of fissile materials.** DeVolpi, A. Argonne National Lab., IL (United States). Mar 1994. 96p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012372. Source: OSTI; NTIS; GPO Dep.

Plutonium demilitarization and disposal are timely and highly technical (but politicized) public-interest issues: What should be done with the huge surplus of fissile materials emerging from the curtailment and reversal of the nuclear-arms race? After comprehensively reviewing the relevant literature dating to the 1970s, this update examines the technical properties of plutonium and analyzes the published options for its disposition. Both the near-term and long-term disposal of plutonium pose unresolved national and international policy issues. Of special concern is weapons-grade plutonium being separated from dismantled nuclear weapons. Monitored storage, material reutilization, isotopic dilution or transformation, and space expulsion are the primary disposal alternatives. Plutonium and uranium can be effectively demilitarized by mixing with lower isotopic grades. Vitrification and storage of all plutonium have the support of those who oppose burnup in nuclear reactors. Reutilization and demilitarization could be encompassed by once-through burnup as mixed-oxide fuel in existing nuclear-power reactors, or by closed-cycle annihilation in special government reactors. Because reactor-grade plutonium has been habitually avoided in making weapons, burnup would be a very effective measure in denying expeditious military use of plutonium by nuclear-weapons states. Safeguards, verification, and environmental factors are also examined. Through coordinated national and international policies on the control and disposal of fissile materials, sensible and effective approaches to nonproliferation can be formulated.

21921 (ANL/EP/PP–71829) **Tags and seals to strengthen arms control verification.** DeVolpi, A. Argonne National Lab., IL (United States). 3 Oct 1990. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94011359. Source: OSTI; NTIS; GPO Dep.

Tags and seals have long been recognized as important tools in arms control. The trend in control of armaments is to limit militarily significant equipment that is capable of being verified through direct and cooperative means, chiefly on-site inspection or monitoring. Although this paper will focus on the CFE treaty, the role of tags and seals for other treaties will also be addressed. Published technology and concepts will be reviewed, based on open sources.

Arms control verification tags are defined as unique identifiers designed to be tamper-revealing; in that respect, seals are similar, being used as indicators of unauthorized access. Tamper-revealing tags are intended as single-point markers, seals for two-point couplings, and nets for volume containment. Seals usually bind two separate components, such as a hatch or flange that provides access to a secure compartment or a valve that controls fluid flow. A tamper-revealing net might be comprised of a coupled fiberoptic bundle wrapped around an object. Sometimes the term "seal" is used to denote the tamper-revealing feature of a tag that is attached to a surface, but in this paper the tamper-indicating connection is considered to be part of the tag concept itself.

21922 (LA-UR–94-1077) **Video imaging for Nuclear Safeguards.** Bradley, J.N.; Brislawn, C.M.; Brown, J.E.; Rodriguez, C.A.; Stoltz, L.A. Los Alamos National Lab., NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9403105–1: Industrial data compression workshop and conference, Snow Bird, UT (United States), 30 Mar - 1 apr 1994). Order Number DE94009330. Source: OSTI; NTIS; GPO Dep.

The field of Nuclear Safeguards has received increasing amounts of public attention since the events of the Iraq-UN conflict over Kuwait, the dismantlement of the former Soviet Union, and more recently, the North Korean resistance to nuclear facility inspections by the International Atomic Energy Agency (IAEA). The role of nuclear safeguards in these and other events relating to the world's nuclear material inventory is to assure safekeeping of these materials and to verify the inventory and usage of these materials as reported by states that have signed the Nuclear Nonproliferation Treaty. Nuclear Safeguards are measures prescribed by domestic and international regulatory bodies and implemented by the nuclear facility or the regulatory body. These measures include destructive and nondestructive analysis of product materials and process by-products for materials control and accountancy purposes, physical protection for domestic safeguards, and containment and surveillance for international safeguards. In this presentation we will introduce digital video image processing and analysis systems that have been developed at Los Alamos National Laboratory for application to the nuclear safeguards problem. Of specific interest to this audience is the detector-activated predictive wavelet transform image coding used to reduce drastically the data storage requirements for these unattended, remote safeguards systems.

21923 (LA-UR–94-1191) **Axisymmetric magnetic gauges.** Wright, B.L.; Alrick, K.R.; Fritz, J.N. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–2: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94011655. Source: OSTI; NTIS; GPO Dep.

Axisymmetric magnetic (ASM) gauges are useful diagnostic tools in the study of the conversion of energy from underground explosions to distant seismic signals. Requiring no external power, they measure the strength (particle velocity) of the emerging shock wave under conditions that would destroy most instrumentation. Shock pins are included with each gauge to determine the angle of the shock front. For the Non-Proliferation Experiment, two ASM gauges were installed in the ANFO mixture to monitor the detonation wave and 10 were grouted into boreholes at various ranges in the surrounding rock (10 to 64 m from the center of explosion). These gauges were of a standard 3.8-inch-diameter design. In addition, two unique Jumbo ASM gauges (3-ft by 3-ft in cross section) were grouted to the wall of a drift at a range of 65 m. We discuss issues encountered in data analysis, present the results of our measurements, and compare these results with those of model simulations of the experiment.

21924 (LA-UR–94-1224) **Ionospheric measurements for the Non-Proliferation Experiment.** Fitzgerald, T.J. Los Alamos National Lab., NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404100–3: Symposium on the non-proliferation experiment results and implications for test ban treaties, Rockville, MD (United States), 19-21 Apr 1994). Order Number DE94011659. Source: OSTI; NTIS; INIS; GPO Dep.

The detection of explosions using ionospheric techniques relies on measuring perturbations induced in radio propagation by acoustics waves which disturb the electron density of the ionosphere. Such techniques have been applied to the detection of atmospheric explosions, underground nuclear tests, earthquakes, and surface mining explosions. The nighttime ionosphere presents a difficulty for the detection of explosions because in the absence of solar ionization radiation the electron density in the altitude range of 90 to 200 km decays after sunset and perturbation effects are correspondingly reduced. On the other hand, acoustic waves produced by weak sources reach a maximum amplitude in the altitude range of 100 to 150 km and are highly attenuated at altitudes above 200 km. For safety reasons, most planned explosions are conducted during daylight which has limited the experimental measurements during nighttime. However a recent opportunity for a nighttime measurement occurred in connection with the Non-Proliferation Experiment which consisted of the detonation of a large chemical charge underground at the Nevada Test Site near midnight local time. the results, based on a new technique of using medium frequency radio transmissions provided by commercial broadcasts to detect explosion effects, were negative. The most likely explanation for the negative result is that the radio transmissions did not reflect at a low enough altitude to sense the perturbations produced by the acoustic waves.

21925 (PNL-SA–23640) **International Nuclear Safeguards Inspection Support Tool.** Steinmaus, K.L.; Wukelic, G.E.; Beal, O.M. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940307–27: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94011675. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) is committed to developing technologies to meet escalating requirements for the International Atomic Energy Agency (IAEA) Non-Proliferation Treaty (NPT) monitoring and associated inspections. This commitment involves the customization and transfer of existing remote monitoring/information management technologies for use by the IAEA. This paper describes an information management system called INSIST International Nuclear Safeguards Inspection Support Tool, which was developed by the Pacific Northwest Laboratory (PNL) to support the IAEA Action Team in its role of monitoring and verifying compliance under United Nations Special Commission (UNSC) Resolutions 687, 707, and 715. Initial emphasis was placed on developing and deploying functionality and databases customized to support the Action Team. Throughout the design and customization of INSIST, emphasis was placed on information storage and retrieval capabilities for data gathered by the Action Team. In addition, PNL provided the Action Team with maps and satellite images and other relevant Iraqi databases to further facilitate the following activities: monitoring nuclear activities, facility operations, and nuclear material inventories assisting in inspection planning and training providing post inspection analysis providing onsite inspection support reporting on inspection findings.

36 MATERIALS

Refer also to citation(s) 21715, 22777, 23015

3601 Metals and Alloys

Refer also to citation(s) 20799, 20811, 20814, 20852, 20863, 20864, 20865, 20980, 20983, 21198, 21320, 21346, 21352, 21394, 21395, 21397, 21408, 21418, 21455, 21462, 21467, 21468, 21552, 21836, 22016, 22047, 22164, 22187, 22204, 22242, 23177, 23179, 23180

21926 (ANL/ET/CP–81945) **Fabrication and properties of Ag-clad Bi-2223 conductors and magnets.** Balachandran, U. (Argonne National Lab., IL (United States)); Iyer, A.N.; Haldar, P.; Hoehn, J.G. Jr.; Motowidlo, L.R. Argonne National Lab., IL (United

States); IGC/Advanced Superconductors, Inc., Waterbury, CT (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940651–3: International workshop on superconductivity: critical current of high-temperature superconductors and related topics, Kyoto (Japan), 6-9 Jun 1994). Order Number DE94011502. Source: OSTI; NTIS; GPO Dep.

Significant progress has been made in fabricating Ag-clad Bi-2223 tapes that are suitable for practical applications. Long lengths (≈100 m) of tapes with high transport critical current density (J_c) were fabricated by the powder-in-tube technique, starting with partially reacted precursor powders. The tapes were given appropriate heat treatment, and growth of the 2223 phase at each step of the heat treatment was studied. At 77 K, J_c values of $>4 \times 10^4$ A/cm^2 and $\approx 1.5 \times 10^4$ A/cm^2 have been achieved in short-length and ≈70-m-long tapes, respectively. Compact and robust pancake coils were fabricated from the tapes by the wind-and-react method. Pancake coils were stacked in series to make magnets. The coils and magnets were characterized as a function of applied magnetic fields at various temperatures. A magnet containing 10 pancake coils (≈480 m of conductor) generated magnetic fields as high as 2.6, 1.8, 0.53, and 0.36 T at 4.2, 27, 64, and 77 K, respectively. Progress in the manufacturing of long lengths of Bi-2223 conductors and their performance are presented.

21927 (ANL/IPNS/CP–83050) **Magnetic response of ultrathin Fe on MgO: A polarised neutron reflectometry study.** Adenwalla, S. (Argonne National Lab., IL (United States)); Park, Y.; Felcher, G.P.; Teitelman, M. Argonne National Lab., IL (United States). May 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940629–6: 6. joint conference on magnetism and magnetic materials, Albuquerque, NM (United States), 20-23 Jun 1994). Order Number DE94013192. Source: OSTI; NTIS; GPO Dep.

The magnetization of ultrathin bcc Fe films (two and three monolayers) on MgO was measured and compared with the behavior predicted for a 2-dimensional ferromagnet. The experiment indicated that no hysteresis was present in the magnetization. Instead, the magnetization at low temperature was affected by a marked fuel cooling effect. These observations lead to the conclusion that films of Fe on MgO of such thickness exhibit superparamagnetic behavior as if they were not entirely continuous. In contrast, films thicker than five monolayers exhibit a magnetic response close to that of bulk iron.

21928 (ANL/MSD/PP–71721) **In situ studies of amorphization of the Ge-Al and Si-Al systems induced by 1 MeV electron irradiation.** Lin, X.W. (Northwestern Univ., Evanston, IL (United States)); Seidman, D.N.; Okamoto, P.R. Argonne National Lab., IL (United States). Oct 1990. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012630. Source: OSTI; NTIS; GPO Dep.

Ge/Al and Si/Al bilayer specimens, as well as Al-2.3 at. % Ge two-phase alloy specimens, were irradiated in situ with 1 MeV electrons at temperatures in the range 10–190 K in a high voltage electron microscope. At 10 K, it is found that for a Ge/Al bilayer specimen, amorphization at the interface occurs only when the Ge layer faces the incident electron beam, while for a Si/Al bilayer specimen amorphization occurs regardless of the direction of the incident beam. In this case, the critical fluence for amorphization (Φ_c) to occur is $\approx 3 \times 10^{23}$ cm^{-2} (≈ 30,19 and 18 displacements per atom in Ge, Si and Al respectively). In the case of Al – 2.3 at. % Ge alloy specimens irradiated at 10 and 50 K a crystalline-to-amorphous (c-to-a) transition is observed at $\Phi_c \approx 2.4 \times 10^{23}$ cm^{-2} (24 and 14 dpa in Ge and Al respectively). The temperature dependence of Φ_c is also studied for a Ge/Al bilayer specimen. The value of Φ_c is a constant for $T < \approx 160$, and then it increases rapidly with increasing T; Φ_c becomes immeasurably large at a critical temperature of ≈ 190 K. The results can be understood in terms of an electron-irradiation-induced recoil-implantation mechanism.

21929 (ANL/MSD/PP–77633) **The effect of the shape function on small-angle scattering analysis by the maximum entropy method.** Jemian, P.R. (Argonne National Lab., IL (United States)); Allen, A.J. Argonne National Lab., IL (United States). 15 Sep 1992. 29p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract NAG8-144. Order Number DE94013421. Source: OSTI; NTIS; GPO Dep.

Analysis of small-angle scattering data to obtain a particle size distribution is dependent upon the shape function used to model the scattering. Using a maximum entropy analysis of small-angle scattering data, the effect of shape function selection on obtained size distribution is demonstrated using three different shape functions to describe the same scattering data from each of two steels. The alloys have been revealed by electron microscopy to contain a distribution of randomly oriented and mainly non-interacting, irregular, ellipsoidal precipitates. Comparison is made between the different forms of the shape function. Effect of an incident wavelength distribution is also shown. The importance of testing appropriate shape functions and validating these against other microstructural studies is discussed.

21930 (BNL–60347) **Interfaces of high-protection performance polyaryls-coated zinc phosphated steels.** Sugama, T. Brookhaven National Lab., Upton, NY (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9406167–1: Tri-service conference on corrosion, Orlando, FL (United States), 21-24 Jun 1994). Order Number DE94011732. Source: OSTI; NTIS; GPO Dep.

To evaluate the ability of polyaryl thermoplastic coatings such as polyphenylenesulfide (PPS) and polyphenyletheretherketone (PEEK), to protect zinc phosphate (Zn·Ph)-treated steels from corrosion in a wet, harsh environment (1.0 wt % H_2SO_4, 3.0 wt % NaCl and 96.0 wt % water at temperature from 250 to 200 C), we exposed them in autoclave to determine performance in heating-cooling cyclic fatigue tests (1 cycle = 12 hr at 200 C + 12 hr at 25 C) for up to 90 cycles. Although no changes in appearance were seen in the PEEK specimens after 60 cycles, extension to 90 cycles caused delamination of the coating film from the Zn·Ph; the major reason was the degradation of the PEEK polymer caused by its hydrothermalcatalyzed esterification. In urea hydrogen peroxide (UHP)-modified PPS-coating systems, chemical reactions at the interfaces between the PPS and Zn in the Zn·Ph layer led to the formation of a ZnS reaction product, which enhanced the Zn·Ph-to-PPS adhesive bond; correspondingly, there were no signs of peeling nor separation of the coating after 90 cycles. In addition, because these intermediate reaction products are insoluble at high pH, they minimized the rate of delamination of the PPS coating caused by the cathodic reaction, $H_2O + 1/2O_2 + 2e^- \rightarrow 2OH^-$, at the corrosion side of a defect in the film. In contrast, PEEK coatings containing non-reactive Zn·Ph underwent cathodic delamination because of the susceptibility of Zn·Ph to alkali dissolution.

21931 (CONF-9308122–18) **Mechanical behavior and phase stability of NiAl-based shape memory alloys.** George, E.P. (Oak Ridge National Lab., TN (United States). Metals and Ceramics Div.); Liu, C.T.; Horton, J.A.; Kunsmann, H.; King, T.; Kao, M. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Union of Materials Research Societies on advanced materials; Tokyo (Japan); 31 Aug - 4 sep 1993. Order Number DE94012336. Source: OSTI; NTIS; GPO Dep.

NiAl-based shape memory alloys (SMAs) can be made ductile by alloying with 100–300 wppm B and 14–20 at.% Fe. The addition of Fe has the undesirable effect that it lowers the temperature (A_p) of the martensite → austenite phase transformation. Fortunately, however, A can be raised by lowering the "equivalent" amount of Al in the alloy. In this way a high A_p temperature of ~190 C has been obtained without sacrificing ductility. Furthermore, a recoverable strain of 0.7% has been obtained in a Ni-Al-Fe alloy with A_p temperature of ~140 C. Iron additions do not suppress the aging-induced embrittlement that occurs in NiAl alloys at 300–500 C as a result of Ni_5Al_3 precipitation. Manganese additions (up to 10 at.%) have the effect of lowering A_p, degrading hot workability, and decreasing room-temperature ductility.

21932 (CONF-931009–25) **Pair correlations in crystalline solid solutions.** Ice, G.E. (Oak Ridge National Lab., TN (United States)); Sparks, C.J.; Shaffer, L.; Zschack, P. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC05-84OR21400. From Fall meeting of the Minerals, Metals and Materials Society: physical metallurgy and materials; Pittsburgh, PA (United States); 17-21 Oct 1993. Order Number DE94012319. Source: OSTI; NTIS; GPO Dep.

Recent measurements of pair correlations in metallic solid solutions challenge simple models of atomic size in alloy structure. These measurements take advantage of intense and tunable synchrotron X radiation to control the x-ray scattering contrast between atoms in a solid solution. For binary alloys with elements nearby in the periodic table it is possible to tune the x-ray energy near the K edge so that the scattering contrast varies from near zero to ± 5 electron units. Even larger contrast variation is possible near L edges or with complementary x-ray and neutron diffraction data sets. With adjusted scattering contrast it is possible to measure short-range-order (SRO), even in alloys with elements nearby in the periodic table. It is also possible to detect chemically-specific static displacements of ± 0.001 Å or less and with fewer assumptions than with previous experimental methods. We compare the measured chemically-specific static displacements in $Fe_{22.5}Ni_{77.5}$ and $Cr_{47}Fe_{53}$ with previous models and with the results of other experiments.

21933 (CONF-931269–, pp. 249-252) **Electric structure of hydrated nickel oxide electrochromic thin films.** Yoshimura, K. (National Industrial Research Institute of Nagoya, Nagoya (Japan)); Miki, T.; Tazawa, M.; Kin, H.; Igarashi, K.; Tanemura, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

Investigations were made by using XPS and EELS on electrochromic structure of hydrated nickel oxide thin films (with a thickness of 150 nm) prepared by a magnetron sputtering process in a state just after the films have been grown, a colored state after coloring and bleaching have been repeated 100 times by means of voltammetry, and a bleached state. This paper describes the following matters on the result thereof: the XPS spectra of Ni2p shells agree with those for NiO, showing very little difference in the three kinds of state; the XPS spectra for O 1s shells vary noticeably among the as-grown, colored and bleached states, and the as-grown films have a peak appearance that shows NiOx (x>1) being contained in addition to NiO; the EELS spectra in the as-grown state agree with those for single NiO crystals; and the peaks attributable to interband transition of the EELS spectra have the intensities different in each of the three kinds of state. 12 refs., 8 figs.

21934 (CONF-940416–12) **Thermal and mechanical behavior of $Ba_{1+x}Zr_4P_{6-2x}Si_{2x}O_{24}$.** Shanmugham, S. (Univ. of Tennessee, Knoxville, TN (United States). Dept. of Materials Science and Engineering); More, K.L.; Stinton, D.P.; Hubbard, C.R.; Cavin, O.B.; Porter, W.O.; Ferber, M.K.; Limaye, S.Y.; Jackson, B.T. Oak Ridge National Lab., TN (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 96. annual meeting of the American Ceramic Society; Indianapolis, IN (United States); 24-28 Apr 1994. Order Number DE94013620. Source: OSTI; NTIS; GPO Dep.

$Ba_{1+x}Zr_4P_{6-2x}O_{24}$ or BS compounds ($o \leq x \leq 0.5$) were synthesized by the sintering of powders formed by a solid-state reaction. Thermal and mechanical properties of BS were studied as a function of composition. It was found that the bulk linear thermal expansion varied with increasing x and was negative for BS with x = 0.5. Among the BS compositions investigated, BS with x = 0.375 had the highest flexural strength, Young's modulus and hardness.

21935 (CONF-9405100–6) **First principles simulation of materials properties.** Shelton, W.A. (Oak Ridge National Lab., TN (United States)); Stocks, G.M.; Pinski, F.J.; Jordan, R.G.; Liu, Y.; Qui, L.L.; Staunton, J.B.; Johnson, D.D.; Ginatempo, B. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Scalable high performance computing conference; Knoxville, TN (United States); 23 May 1994. Order Number DE94013615. Source: OSTI; NTIS; GPO Dep.

We have developed a hybrid, parallel computer code for calculating the electronic structure of both ordered and substitutionally disordered materials. By using PVM3.3, we can integrate into our local computer environment multiple parallel and vector superconductors as well as high performance workstations. Without this approach, calculations of materials properties of large systems would be otherwise untenable due to a lack of computer resources. For example, we have determined the short-range order intensity and its electronic origin for the Ag-Mg alloy system, including an estimate of the order-disorder (spinodal) temperature.

21936 (CONF-940692–4) **Residual stresses in a multi-pass weld in an austenitic stainless steel plate before and after thermal stress relief.** Spooner, S.; Wang, X.L.; Hubbard, C.R.; David, S.A. Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. international conference on residual stress (ICRS-4); Baltimore, MD (United States); Jun 1994. Order Number DE94013278. Source: OSTI; NTIS; GPO Dep.

Changes in residual stresses due to thermal stress relief were determined in a welded 1/2 in. thick 304 stainless steel plate from two residual stress maps determined with the neutron diffraction technique. The 304 stainless plate was made from two 6 x 12 x 1/2 in. pieces joined along the length by a gas tungsten arc welding process. Multi-pass welds were made with a semiautomatic welding machine employing cold-wire feed of type 308 stainless steel filler alloy. The thermal stress relief treatment consisted of heating to 1150 F, holding for one hour at temperature and then air cooling. Strain components were measured along the weld direction (longitudinal), perpendicular to the weld line in the plate (transverse), and normal to the plate. Measurements were confined to the plane bisecting the weld at the center of the plate. The strain components were converted to stresses assuming that the measured strains were along the principal axes of the strain tensor. Parameters used in the calculation were E=224 GPa and v=0.25. As-welded longitudinal stresses are compressive in the base metal and become strongly tensile through the heat affected zone and into the fusion zone. The transverse stresses follow the longitudinal trend but with a lower magnitude while the normal stresses are small throughout. The stress relief treatment reduced the magnitudes of all the stresses. In the weld zone the longitudinal stress was lowered by 30% and the spatial range of residual stresses was reduced as well.

21937 (CONF-940692–5) **Investigation of residual stresses in a multipass weld in 1 in. stainless steel plate.** Spooner, S. (Oak Ridge National Lab., TN (United States)); Fernandez Baca, J.A.; David, S.A.; Hubbard, C.R.; Holden, T.M.; Root, J.H. Oak Ridge National Lab., TN (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. international conference on residual stress (ICRS-4); Baltimore, MD (United States); Jun 1994. Order Number DE94013277. Source: OSTI; NTIS; GPO Dep.

Residual stresses and strains were measured in two welded 25-mm thick plates of type 304 stainless steel by the neutron diffraction. The filler metal was type 308 stainless steel and the weld zone had a two phase microstructure in which the austenitic phase lattice parameter differs from the base metal. In these circumstances stain-free samples were taken from the weld zone area for analysis of the lattice parameters and ferrite content using neutron powder diffraction. Corrections for lattice parameter variation were applied permitting the calculation of residual strains and stresses in weld zone, heat affected zone (HAZ) and base metal. One of the two welds was examined without stress relief and the other was given a stress relief treatment consisting of vibration at a frequency below the resonant condition dudng welding. In both plates the largest residual stress component (longitudinal) is found in the fusion zone near the boundary between the weld zone and the heat affected zone. This longitudinal component is 400 $\pm$ 50 MPa in tension. The normal stresses are generally close to zero

although large fluctuations are found in the weld zone. The transverse stresses are as high as 200 MPa in the weld zone and decrease to 50 MPa ± 40 MPa. The lattice parameter variation was equivalent to 5 × l0−4 compressive strain and the ferrite content approached 9 percent at the center of the weld zone. Variations in residual stresses with thickness through the base metal plate were small. The treated plate and untreated plate showed nearly identical patterns of stress distribution. Differences in the measured stresses between vibratory-stress-relief treated and untreated plates fall within error bars of the stress determination in these particular 25 mm thick 300-type stainless steel plates.

21938 (CONF-9406127–2) **Errors induced in triaxial stress tensor calculations using incorrect lattice parameters.** Ruud, C.O. (Pennsylvania State Univ., University Park, PA (United States). Materials Research Lab.); Kozaczek, K.J. Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1994 Society for Experimental Mechanics (SEM) spring conference on experimental mechanics; Baltimore, MD (United States); 6-8 Jun 1994. Order Number DE94013256. Source: OSTI; NTIS; GPO Dep.

A number of researchers have proposed that for some metallic alloys, an elaborate procedure is necessary in order to improve the accuracy of the measured triaxial stress tensor. Others have been concerned that the uncertainties in establishing the precise zero-stress lattice parameter of an alloyed and/or cold worked engineering metal could cause significantly more error than would result in ignoring the triaxial stress state and assuming the plane stress condition. This paper illustrates the effect of uncertainties in the zero-stress lattice parameters on the calculated triaxial stress state for zero stress powders of three common engineering alloys, i.e., 1010 steel, 304 stainless steel, and 2024 aluminum. Also, errors due to the incorrect lattice spacing in experimental stress analysis are presented for three examples, i.e., a silicon powder, 304 gainless steel cylinder and a diamond. For cases where the plane strain assumption is justified, the uncertainties due to the stress free lattice parameter can be reduced by a simple measurement.

21939 (CONF-940753–8) **Atomic level characterization of defects in microalloyed NiAl: An atom probe investigation.** Jayaram, R.; Miller, M.K. Oak Ridge National Lab., TN (United States); Oak Ridge Inst. for Science and Education, TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; AC05-76OR00033. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012732. Source: OSTI; NTIS; GPO Dep.

Since mechanical behavior is largely controlled by the microstructure (particularly dislocations, substitutional solutes, and solute segregation to grain boundaries) atom probe field ion microscopy is well suited to studying such microstructural features. The atom probe has been used to explain changes in yield stress when NiAl is doped with B, C, Be, or Zr/Mo. It showed that the beneficial effect of B segregation is masked by formation of ultrafine, deleterious second-phase particles. Be occupied Al sites almost exclusively. Zr segregated to both grain boundaries and dislocations.

21940 (CONF-940753–9) **AEM and AES of radiation-induced segregation in proton-irradiated stainless steels.** Kenik, E.A. (Oak Ridge National Lab., TN (United States)); Carter, R.D.; Damcott, D.L.; Atzmon, M.; Was, G.S. Oak Ridge National Lab., TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012734. Source: OSTI; NTIS; GPO Dep.

In order to avoid complications from long-term induced radioactivity of neutron-irradiated specimens, 4 type 304L alloys were irradiated to 1 dpa with 3.4 MeV protons at 400 C. Analytical electron microscopy and Auger electron spectrometry were used to measure composition at and near grain boundaries in controlled purity alloys. As a result of the narrow RIS profiles (<20 nm width) at grain boundaries induced in these materials by low temperature irradiation and the finite size of the excited volume for x-ray microanalysis, the measured profiles are convolutions of these two factors.

21941 (CONF-940753–10) **The effect of reactive elements on the segregation behavior and microstructure of α-Al_2O_3 scales on β-NiAl.** Alexander, K.B.; Pint, B.A. Oak Ridge National Lab., TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012739. Source: OSTI; NTIS; GPO Dep.

In order to improve oxidation resistance, small amounts of oxygen- active or "reactive" elements (RE) such as Y, Zr, Hf, Ce are added to chromia- and alumina-forming high-temperature alloys. As an alternative to a system where the RE-ion supply is self-limiting (Y-implant), it was desired to study effect of RE source-removal on microstructure and grain boundary segregation levels. β-NiAl doped with 0.23 wt% Zr was oxidized in oxygen at 1500 C for 50 h. Upon cooling, the scale spalled into pieces; these spalled α-Al_2O_3 scales were then annealed in air at 1500 C for 1 and 50 h. Specimens were fabricated parallel to metal/scale interface, and grain boundary chemistries were determined using X-ray energy dispersive spectrometry. Results show that no qualitative change in microstructural scale or zirconia particle size/density occurs after annealing, which is consistent with the model in which the gas- interface microstructure development depends on a continuous supply of zirconia diffusing from the metal interface towards the gas interface.

21942 (CONF-940766–4) **Elemental mapping of segregation in stainless steels with an imaging filter.** Bentley, J.; Kenik, E.A. Oak Ridge National Lab., TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 13. international congress on electron microscopy; Paris (France); 17-22 Jul 1994. Order Number DE94012659. Source: OSTI; NTIS; GPO Dep.

Two types of solute segregation was studied in 300-series stainless steels. Elemental mapping was performed at 200 kV with Gatan Imaging Filters (GISs) attached to electron microscopes. Results show that a GIF can be used to study solute segregation in stainless steels, that image acquisition and processing are straightforward and rapid, but that large probe currents and low specimen drift rates are essential. 4 figs, 6 refs.

21943 (DOE/ER/12895–T1) **Studies of low temperature, low flux radiation embrittlement of nuclear reactor structural materials: Final report.** Odette, G.R.; Lucas, G.E. California Univ., Santa Barbara, CA (United States). Dept. of Chemical and Nuclear Engineering. 1 Jun 1993. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER12895. Order Number DE94013710. Source: OSTI; NTIS; GPO Dep.

There are several existing research programs which have components pertinent to the issue of low flux/low temperature embrittlement; in particular, examination of the Shippingport shield tank which has been exposed to low flux and relatively low temperature is being performed by ANL, and evaluation of low temperature embrittlement in A508 and A533B steels in support of the HTGR is currently being performed by ORNL. However, these programs are not specifically directed at the broader issue of low flux/low temperature embrittlement in a range of structural steels. Hence, the authors coordinated their effort with these programs so that their investigations were complementary to existing programs, and they focused on a set of materials which expand the data base developed in these programs. In particular, the authors have investigated embrittlement phenomena in steels that are similar to those used in support structure.

21944 (DOE/ER/45211–23) **[Experimental studies of the structure, chemistry, and properties of grain boundaries]: [Annual report, June 1, 1993–May 31, 1994].** Sass, S.L. Cornell Univ., Ithaca, NY (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45211. Order Number DE94012900. Source: OSTI; NTIS; GPO Dep.

Observations have shown that the APB energy in boron-doped grain boundaries in Ni_3Al decreases with increasing misorientation angle. Boron segregation to a grain boundary in Ni_3Al has been observed for the first time using EELS. The boron distribution along a large angle grain boundary in $Ni_{0.76}Al_{0.24}$ was shown to be not uniform. The boron-rich regions of the grain boundary were seen to have similar nickel bonding to bulk Ni_3Al. Undoped and boron-poor regions of the grain boundary have bonding similar to that in pure Ni (less filled Ni d bands) which suggests these Ni atoms have fewer Al nearest neighbors and weaker Ni-Al bonding than in bulk Ni_3Al. Finally, radiation damage was seen to occur in freshly prepared specimens at beam voltages as low as 100 kV but could be prevented by carbon coating the samples.

21945 (DOE/ER/45239–9) **Atomic and electronic structure of metals and alloys: Rare earths, ultrathin films and surface alloys: Final report, [October 1, 1988–December 31, 1993].** State Univ. of New York, Stony Brook, NY (United States). Research Foundation. [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER45239. Order Number DE94011581. Source: OSTI; NTIS; GPO Dep.

The project has been productive: 47 refereed publications in about 5 years. While confined to the area of surfaces and thin films, the project has covered a wide range of physical properties and different materials: rare earths, bulk and surface alloys, metal surfaces, magnetism, and (especially) atomic and electronic structure of ultrathin films. Notable achievements include quantitative studies of atomic structure of clean rare-earth surfaces: Tb(0001), Tb(11$\bar{2}$0), Gd(0001), and Gd(11$\bar{2}$0). Surface alloys studied included Cu{001}c(2 x 2)-Au and Cu{001}c(2 x 2)-Pd. The most important achievement of the project lies in the application of quantitative low-energy electron diffraction to ultrathin films, particularly magnetic metals on nonmagnetic substrates (e.g., Fe on Ag{001}, etc.) (No data given.)

21946 (DOE/ER/45403–5) **Atomic structures and compositions of internal interfaces: Progress report, September 1, 1993–August 31, 1994.** Seidman, D.N. (Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering); Merkle, K.L. Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering. 14 Jun 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45403. Order Number DE94013594. Source: OSTI; NTIS; GPO Dep.

An atomic scale study was made of the Ag/CdO(222) heterophase interface produced by internal oxidation of a Ag(Cd) alloy, using HREM and atom-probe field-ion microscopy (APFIM). A study was commenced of interfacial segregation at metal/metal oxide interfaces; the system being studied is the Cu(Ag)/MgO(222) heterophase interface, where Ag is the segregating species. A study was made of the necessary conditions to measure the oxygen content in MgO precipitates produced by internal oxidation of Cu(Mg) alloys, using APFIM. We are also studying solute-atom segregation at grain boundaries in Ni-Pd alloys via computer simulations and combined APFIM/TEM.

21947 (DOE/FTR–5435) **Travel to assess Ukraine and Russian materials and processes technology in the areas of refractory metals, super alloys, and casting: Foreign trip report, September 15–October 3, 1993.** Hayes, D.; Zanner, F. Sandia National Labs., Albuquerque, NM (United States). 6 Jan 1994. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94005435. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document is the record of a trip taken in September and October of 1993 to the Former Soviet Union by Dennis Hayes and Frank Zanner of Sandia National Laboratories (SNL). They were accompanied by their wives Janet Hayes and Mary Ann Zanner. Purpose of the trip was to assess Ukraine and Russian materials and processes technology in the areas of refractory metals, super alloys, and casting to identify "islands of excellence" that would be of interest to US Industry. The document contains a day-by-day chronology of the trip.

21948 (DOE/ID/13053–9) **Advanced materials for the energy efficient production of aluminum: Final report.** Sadoway, D.R. Massachusetts Inst. of Tech., Cambridge, MA (United States). Materials Processing Center. May 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-91ID13053. Order Number DE94011197. Source: OSTI; NTIS; GPO Dep.

The Hall process has always suffered from important problems, among which is the use of consumable carbon anodes, hence, attempts had been made in the past to find an inert anode. A different approach was taken in the present research: a metal anode covered by a protective oxide film is operated so that the film is thick enough to prevent chemical attack of underlying metal, yet thin enough to allow electric current to pass without increase in cell voltage. Specimens of various candidate alloy compositions (Cu-Al, Ni-Al, Cr-Al, Fe-Cr-Al) were electrolyzed; results are promising. Areas for further research on nonconsumable anode for Hall cell are outlined.

21949 (DOE/PC/92521–T149) **Chlorine in coal and its relationship with boiler corrosion: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Chou, M.I.M. (Illinois State Geological Survey, Champaign, IL (United States)); Lytle, J.M.; Ruch, R.R.; Chou, C.L. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012576. Source: OSTI; NTIS; GPO Dep.

Limited literature and use history data have suggested that some high-chlorine Illinois coals do not cause boiler corrosion while extensive data developed by the British correlate corrosion with chlorine content and other parameters related to the coal and boiler. The differences in corrosivity in coals may be due to the coal properties, to blending of coals, or to the boiler parameters in which they were burned. The goals of this study focus on coal properties and are: (1) to characterize chlorine and other constituents in coals which have been reported to behave differently with respect to corrosion problems during combustion; (2) to determine the evolution profiles of chlorine-containing compounds in coals during pyrolysis and oxidation; and (3) to examine the behavior of Cl-, S-, N-, O-containing compounds in coal during pyrolysis. Proximate, ultimate, and ash composition analyses for all of the British and Illinois coal samples were completed in this quarter. Analysis of the acid-soluble sodium and potassium in coals is in progress. These data, along with ash composition data, will be used to assess a coal's relative corrosion potential. The HCl evolution profiles obtained from oxidation of the five Illinois coal samples were examined. The results indicate that temperatures of maximum HCl evolution range were 430°C to 450°C.

21950 (DOE/PC/92542–T6) **Robotic weld overlay coatings for erosion control: Quarterly technical progress report, January 1994–March 1994.** Levin, B.F.; Dupont, J.N.; Marder, A.R. Lehigh Univ., Bethlehem, PA (United States). 21 Apr 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92542. Order Number DE94013477. Source: OSTI; NTIS; GPO Dep.

The erosion of materials by the impact of solid particles has received increasing attention during the past twenty years. Recently, research has been initiated with the event of advanced coal conversion processes in which erosion plays an important role. The resulting damage, termed Solid Particle Erosion (SPE), is of concern primarily because of the significantly increased operating costs which result in material failures. Reduced power plant efficiency due to solid particle erosion of boiler tubes and waterwalls has led to various methods to combat SPE. One method is to apply coatings to the components subjected to erosive environments. Protective weld overlay coatings are particularly advantageous in terms of coating quality. The weld overlay coatings are essentially immune to spallation due to a strong metallurgical bond with the substrate material. By using powder mixtures, multiple alloys can be mixed in order to achieve the best performance in an erosive environment. However, a review of the literature revealed a lack of information on weld overlay coating performance in erosive environments which makes the selection of weld overlay alloys a difficult task. The objective of this project is to determine the effects of weld overlay coating composition and microstructure on erosion

resistance. These results will lead to a better understanding of erosion mitigation in circulated fluidized beds.

21951 (GKSS–93/E/54) **Measures for achieving high cooling rates and short solidification times in the production of metallic powders.** Schimansky, F.P.; Muellauer, G.; Gerling, R. GKSS-Forschungszentrum Geesthacht GmbH (Germany). Inst. fuer Werkstofforschung. 1993. 64p. (In German). Order Number DE94773829. Source: OSTI; NTIS (US Sales Only).

Calculation of cooling rates and solidification times of powder particles are presented. As a function of the powder size, the degree of undercooling and for different cooling conditions (in helium and argon gas and in vacuum) the cooling rates and solidification times of intermetallic TiAl35-powder (wt.%) are calculated. The parameters, which govern the powder particles size distribution under the conditions of a gas atomization are discussed, and the influence of different cooling rates and solidification times on the microstructure of TiAlNb powder particles is shown. (orig.)

21952 (HW–66197-RD) **Suggestion about graphite molds used by plutonium metallurgy operation.** Rider, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jul 1960. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012704. Source: OSTI; NTIS; GPO Dep.

Declassified.

A modification to the design of a bolt ring for fastening the mold plug to the mold body is suggested.

21953 (HW–81446) **Budget for FY 1966 and revised budget for FY 1965: Plutonium processing research and development program.** Frank, W.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Apr 1964. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010925. Source: OSTI; NTIS; GPO Dep.

Declassified.

Budgets are presented for the following projects: plutonium recovery; plutonium reduction development; new products; plutonium–nuclear and chemical safety; and plutonium equipment and instrument development. Project scope and accomplishments are briefly described.

21954 (HW–82486) **Impact properties of plutonium 1% gallium alloy.** Gill, S.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Jun 1964. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010594. Source: OSTI; NTIS; GPO Dep.

Declassified.

This investigation was undertaken to determine the approximate impact characteristics of delta stabilized plutonium 1% gallium alloy, both at room temperature and at 325°C. The testing done was non-standard, primarily because some approximate information was desired for another purpose and immediately available materials were used. While the results reported herein should be considered preliminary, they clearly depict the ductile impact behavior of this alloy.

21955 (IS-M–787) **Characterization of mechanical properties degradation using small punch testing technique.** Kameda, J. Ames Lab., IA (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-940185–1: 4. conference on fossil plant inspection, Palo Alto, CA (United States), 18-20 Jan 1994). Order Number DE94011202. Source: OSTI; NTIS; GPO Dep.

A small punch (SP) testing technique developed at Ames Laboratory and its application to mechanical properties degradation evaluation are summarized. It has been clearly demonstrated on ferritic alloys that the SP test is capable of examining the intergranular embrittling potency of segregated P, Sn and Sb causing temper embrittlement, and the effects of neutron irradiation and post-irradiation annealing, giving rise to changes in the hardness and intergranular solute segregation, on the fracture properties in terms of the ductile-brittle transition temperature (DBTT). A linear relationship between the DBTTs obtained by the SP and Charpy V-notched tests has been theoretically and experimentally established. In model Al alloy substrates coated with Ni-P amorphous (10 μm thick) and overlaying ceramics (0-1.0 μm thick), the global and local fracture properties were well characterized by the SP test together with acoustic emission techniques.

21956 (KFK–5254) **Stress intensity factors and weight functions for cracks in front of notches.** Fett, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Dec 1993. 41p. Order Number DE94773791. Source: OSTI; NTIS (US Sales Only); INIS.

The knowledge of stress intensity factors for cracks at notch roots is important for the fracture mechanical treatment of real components. Stress intensity factor solutions are available only for special notches and externally applied loads. For the treatment of more complex loadings as thermal stresses near the notch root the weight function is needed in addition. In the first part of this report weight functions for cracks in front of internal notches are derived from stress intensity factor solutions under external loading available in the literature. The second part deals with cracks in front of edge notches. Limit cases of stress intensity factors are derived which allow to estimate stress intensity factors for cracks in front of internal elliptical notches with arbitrary aspect ratio of the ellipse and for external notches. (orig.)

21957 (LA–12767-MS) **Dynamic characterization and damage detection in the I-40 bridge over the Rio Grande.** Farrar, C.R.; Baker, W.E.; Bell, T.M.; Cone, K.M.; Darling, T.W.; Duffey, T.A.; Eklund, A.; Migliori, A. Los Alamos National Lab., NM (United States). Jun 1994. 153p. Sponsored by Federal Highway Administration, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013200. Source: OSTI; NTIS; GPO Dep.

In the 1960's and 1970's over 2500 bridges were built in the U.S. with a design similar to those on Interstate 40 over the Rio Grande in Albuquerque, New Mexico. These bridges were built without structural redundancy and typically have only two plate girders carrying the entire dead and live loads. Failure of either girder is assumed to produce catastrophic failure of the bridge, hence these bridges are referred to as fracture-critical bridges. The Federal Highway Administration (FHWA) and the National Science Foundation (NSF) have provided funds to New Mexico State University (NMSU) through the New Mexico State Highway and Transportation Department (NMSH&TD) and The Alliance For Transportation Research (ATR) for evaluation and testing of the existing fracture critical bridges over the Rio Grande. Because the 1-40 bridges over the Rio Grande were to be razed during the summer of 1993, the investigators were able to introduce simulated fatigue cracks, similar to those observed in the field, into the structure in order to test various damage identification methods and to observe the changes in load paths through the structure caused by the cracking. To support this research effort, NMSU contracted Los Alamos National Laboratory (LANL) to perform experimental modal analyses, and to develop experimentally verified numerical models of the bridge. Scientists from the LANL's Condensed Matter and Thermal Physics Group (P-10) applied state-of-the-art sensors and data acquisition software to the modal tests. Engineers from the LANL's Advanced Engineering Technology Group (MEE-13) conducted ambient and forced vibration tests to verify detailed and simplified finite element models of the bridge. Forced vibration testing was done in conjunction with engineers from Sandia National Laboratory (SNL) who provided and operated a hydraulic shaker.

21958 (LA-UR–94-975) **Low temperature phase diagram of YbBiPt.** Movshovich, R. (Los Alamos National Lab., NM (United States)); Lacerda, A.; Canfield, P.C.; Thompson, J.D.; Fisk, Z. Los Alamos National Lab., NM (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940874–1: 6. magnetism and magnetic materials-INTERMAG conference, Albuquerque, NM (United States), 10 Aug 1994). Order Number DE94009345. Source: OSTI; NTIS; GPO Dep.

We report resistivity measurements on the cubic heavy-fermion compound YbBiPt at ambient and hydrostatic pressures to ≈ 19kbars and in magnetic fields to 1 Tesla. The phase transition at

T_c, = 0.4K is identified by a sharp rise in resistivity. We use that feature to build low temperature H-T and P-T phase diagrams. The phase boundary in the H-T plane follows the weak coupling BCS expression remarkably well from T_c, to $T_c/4$, while small hydrostatic pressure of ≈ 1kbar suppresses the low temperature phase entirely. These effects of hydrostatic pressure and magnetic field on the phase transition are consistent with an SDW (Spin Density Wave) formation in a very heavy electron band at T = 0.4K. Outside of the SDW phase at low temperature, hydrostatic pressure increases the T^2 Coefficient of resistivity, signaling an increase in heavy-fermion correlations with hydrostatic pressure. The residual resistivity decreases with pressure, contrary to trends in other Yb heavy-fermion compounds.

21959 (LA-UR–94-1073) **Substitutional effects on the electronic transport of the Kondo insulator $Ce_3Bi_4Pt_3$.** Hundley, M.F.; Canfield, P.C.; Thompson, J.D.; Fisk, Z. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940874–2: 6. magnetism and magnetic materials-INTERMAG conference, Albuquerque, NM (United States), 10 Aug 1994). Order Number DE94009331. Source: OSTI; NTIS; GPO Dep.

The resistivity ρ and thermoelectric power S of the doped Kondo insulator $(Ce_{1-x}La_x)_3Bi_4Pt_3$ are examined to determine the effects of doping on the narrow gap exhibited by this compound. With increasing La concentration the energy gap progressively disappears in both ρ and S and band-like transport develops below 25 K. The T-0 transport energy gap as determined from either ρ or S scales with the single-impurity Kondo energy scale T_K as determined from magnetic susceptibility measurements, independently of x for $x \leq 0.25$. This result strongly suggests that the gap arises from band hybridization that is driven by Kondo-like many-body correlations rather than from single-electronic interactions.

21960 (ORNL/FTR–4876) **Travel to Netherlands to participate as the US representative in meetings held as part of the international Network for Evaluating Steel Components program: Foreign trip report, December 5–12, 1993.** Bass, B.R. Oak Ridge National Lab., TN (United States). 7 Jan 1994. 23p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004969. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary purpose of the trip was to participate as the US representative in meetings held as part of the international Network for Evaluating Steel Components (NESC) program. The NESC was organized as an international forum for the exchange of information on processes of structural integrity assessment, to collaborate on specific projects, and to promote the harmonization of international standards. Membership within the NESC is open to international technical organizations concerned with methods and practices of structural integrity assessment. A joint meeting of the Materials Task Group (TG2) and the Structural Analysis Task Group (TG3) of the NESC was held at the Joint Research Center/Institute of Advanced Materials (JRC/IAM), Petten, Netherlands, on December 7, 1993. This was followed by a meeting of the Evaluation Task Group (TG5) on December 8, 1993 at the same location. These task groups were organized within the NESC to provide support for various elements of the large-scale NESC-1 spinning cylinder project. The NESC-1 experiment will be conducted at AEA Technology, Risley, U.K. for purposes of assessing the behavior of sub-clad and through-clad cracks under thermal-shock loading.

21961 (PPPL–2983) **Fracture testing and performance of beryllium copper alloy C17510.** Murray, H.A.; Zatz, I.J. Princeton Univ., NJ (United States). Plasma Physics Lab. May 1994. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94012552. Source: OSTI; NTIS; INIS; GPO Dep.

When a literature search and discussion with manufacturers revealed that there was virtually no existing data related to the fracture properties and behavior of copper beryllium alloy C17510, a series of test programs was undertaken to ascertain this information for several variations in material processing and chemistry. These variations in C17510 were primarily optimized for combinations of strength and conductivity. While originally intended for use as cyclically loaded high-field, high-strength conductors in fusion energy research, material testing of C17510 has indicated that it is an attractive and economical alternative for a host of other structural, mechanical and electrical applications. ASTM tests performed on three variations of C17510 alloys included both J-integral and plane strain fracture toughness testing and fatigue crack growth rate tests, as well as verifying tensile, hardness, Charpy, and other well defined mechanical properties. Fracture testing was performed at both room and liquid nitrogen temperatures, which bound the thermal environment anticipated for the fusion components being designed. Fatigue crack propagation stress ratios ranged from nominal zero to minus one at each temperature. In order to confirm the test results, duplicate and independent test programs were awarded to separate facilities with appropriate test experience, whenever possible. The primary goal of the test program, to determine and bound the fracture toughness and Paris constants for C17510,was accomplished. In addition, a wealth of information was accumulated pertaining to crack growth characteristics, effects of directionality and potential testing pitfalls. The paper discusses the test program and its findings in detail.

21962 (SAND–93-2513) **An analysis of smoothed particle hydrodynamics.** Swegle, J.W. (Sandia National Labs., Albuquerque, NM (United States)); Attaway, S.W.; Heinstein, M.W.; Mello, F.J.; Hicks, D.L. Sandia National Labs., Albuquerque, NM (United States). Mar 1994. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013817. Source: OSTI; NTIS; GPO Dep.

SPH (Smoothed Particle Hydrodynamics) is a gridless Lagrangian technique which is appealing as a possible alternative to numerical techniques currently used to analyze high deformation impulsive loading events. In the present study, the SPH algorithm has been subjected to detailed testing and analysis to determine its applicability in the field of solid dynamics. An important result of the work is a rigorous von Neumann stability analysis which provides a simple criterion for the stability or instability of the method in terms of the stress state and the second derivative of the kernel function. Instability, which typically occurs only for solids in tension, results not from the numerical time integration algorithm, but because the SPH algorithm creates an effective stress with a negative modulus. The analysis provides insight into possible methods for removing the instability. Also, SPH has been coupled into the transient dynamics finite element code PRONTO, and a weighted residual derivation of the SPH equations has been obtained.

21963 (SAND–93-4039) **Integrated environmentally compatible soldering technologies. Final report.** Hosking, F.M.; Frear, D.R.; Iman, R.L.; Keicher, D.M.; Lopez, E.P.; Peebles, H.C.; Sorensen, N.R.; Vianco, P.T. Sandia National Labs., Albuquerque, NM (United States). May 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013456. Source: OSTI; NTIS; GPO Dep.

Chemical fluxes are typically used during conventional electronic soldering to enhance solder wettability. Most fluxes contain very reactive, hazardous constituents that require special storage and handling. Corrosive flux residues that remain on soldered parts can severely degrade product reliability. The residues are removed with chlorofluorocarbon (CFC), hydrochlorofluorocarbon (HCFC), or other hazardous solvents that contribute to ozone depletion, release volatile organic compounds into the atmosphere, or add to the solvent waste stream. Alternative materials and processes that offer the potential for the reduction or elimination of cleaning are being developed to address these environmental issues. Timing of the effort is critical, since the targeted chemicals will soon be heavily taxed or banned. DOE's Office of Environmental Restoration and Waste Management (DOE/EM) has supported Sandia National Laboratories' Environmentally Conscious Manufacturing Integrated Demonstration (ECMID). Part of the ECM program involves the integration of several environmentally compatible soldering technologies for assembling electronics devices. Fluxless or "low-residue/no clean" soldering technologies (conventional and ablative laser processing, controlled atmospheres, ultrasonic tinning, protective coatings, and environmentally compatible fluxes) have been demonstrated at Sandia (SNL/NM), the University of California at

Berkeley, and Allied Signal Aerospace-Kansas City Division (AS-KCD). The university demonstrations were directed under the guidance of Sandia staff. Results of the FY93 Soldering ID are presented in this report.

21964 (SAND–94-0663) **Description of a high temperature quenching furnace for the study of the directional solidification of nickel-base superalloys.** Schmale, D.T.; Kelley, J.B.; Damkroger, B.K. Sandia National Labs., Albuquerque, NM (United States). Jun 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013812. Source: OSTI; NTIS; GPO Dep.

A high temperature resistance furnace has been modified for the study of directional solidification of nickel-base superalloys such as alloys 718 and 625. The furnace will be used to study segregation and solidification phenomena that occur in consumable-electrode melting processes such as vacuum arc remelting and electro-slag remelting. The system consists of a water cooled high temperature furnace (maximum temperature ~2900 C), roughing vacuum,system, cooling system, cooled hearth, molten metal quenching bath, and a mechanism to lower the hearth from the furnace into the molten metal bath. The lowering mechanism is actuated by a digital stopping motor with a programmable controller. The specimen (1.9 cm dia x 14 cm long) is melted and contained within an alumina tube (2.54 cm dia x 15.24 cm long) which is seated on a copper hearth cooled with ~13 C water. Directional solidification can then be accomplished by decreasing the furnace temperature while holding the specimen in position, maintaining the temperature gradient in the furnace and lowering the specimen at a controlled rate or a combination of both. At any point the specimen can be lowered rapidly into the 70 C molten metal bath to quench the specimen, preserve the solidification structure, and minimize solid state diffusion, enhancing the ability to study the localized solidification conditions.

21965 (SAND–94-1267C) **The influence of VAR processes and parameters on white spot formation in Alloy 718.** Damkroger, B.K.; Kelley, J.B.; Schlienger, M.E.; Van Den Avyle, J.A.; Williamson, R.L.; Zanner, F.J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940663–1: International symposium on superalloys 718, 625, 706 and derivatives, Pittsburgh, PA (United States), 27-29 Jun 1994). Order Number DE94012071. Source: OSTI; NTIS; GPO Dep.

Significant progress has occurred lately regarding the classification, characterization, and formation of white spots during vacuum arc remelting (VAR). White spots have been generally split into three categories: discrete white spots, which are believed to be associated with undissolved material which has fallen in from the shelf, crown, or torus regions; dendritic white spots, usually associated with dendrite clusters having fallen from the electrode; and solidification white spots, believed to be caused by local perturbations in the solidifications conditions. Characteristics and proposed formation mechanisms of white spots are reviewed and discussed in context of physical processes occurring during VAR, such as fluid flow and arc behavior. Where possible, their formation mechanisms will be considered with respect to specific operating parameters. In order to more fully understand the formation of solidification white spots, an experimental program has been begun to characterize the solidification stability of Alloy 718 and variants with respect to changes in growth rate and thermal environment. A description of the experimental program and preliminary results are included.

21966 (SAND–94-1483C) **Corrosive effects of supercritical carbon dioxide and cosolvents on metals.** Russick, E.M.; Poulter, G.A.; Adkins, C.L.J.; Sorensen, N.R. Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406181–1: Joint Army, Navy, NASA, Air Force environmentally benign cleaning and degreasing technical workshop, Indian Head, MD (United States), 14-15 Jun 1994). Order Number DE94012921. Source: OSTI; NTIS; GPO Dep.

With the eventual phase-out of chlorofluorocarbons, and restrictive regulations concerning the use of cleaning solvents such as hydrochlorofluorocarbons, and other volatile organic compounds, it is essential to seek new, environmentally acceptable cleaning processes. In the DOE Complex and in industry, an environmentally sound process for precision cleaning of machined metal parts is one of the issues that needs to be addressed. At Sandia, we are investigating the use of supercritical carbon dioxide (CO_2) as an alternative cleaning solvent for this application. Carbon dioxide is nontoxic, recyclable, and relatively inexpensive. Supercritical CO_2 has been demonstrated as a solvent for many nonpolar organic compounds, including hydrocarbon-based machining and lubricating oils. The focus of this work is to investigate any corrosive effects of supercritical CO_2 cleaning on metals. Sample coupons of several common metals were statically exposed to pure supercritical CO_2, water saturated supercritical CO_2, and 10 wt % methanol/CO_2 cosolvent at 24,138 kPa (3500 psi) and 323K (50C) for 24 hours. Gravimetric analysis and magnified visual inspection of the coupons were performed before and after the exposure tests. Electron microprobe, x-ray photoelectron spectroscopy (XPS), and Auger electron surface analyses were done as needed where visual and gravimetric changes in the samples were evident. Results are reported.

21967 (SR/H–673) **Sensitization for oxalic acid test.** Vaughen, M.R. Hanford Engineer Works, Richland, WA (United States). 18 Oct 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE94006786. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the corrosion testing of stainless steel 304-L at the Savannah River Plant.

21968 (UCRL-ID–110446) **Fatigue and fracture behavior of U-6 wt. pct. Nb.** Strum, M.J.; Freeman, D.C.; Elmer, J.W. Lawrence Livermore National Lab., CA (United States). 21 May 1993. 93p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012988. Source: OSTI; NTIS; INIS; GPO Dep.

The fatigue and fracture properties of U6Nb were measured to provide the materials property data needed for structural designs in material processed by solution quenching and aging 200 C/2h. Limited testing was also performed on as-quenched U6Nb. The authors have extended the database on fatigue properties in U6Nb to include both crack initiation data and crack propagation data. The static load carrying capabilities have been characterized through fracture toughness and tensile property measurements. Using a rotating beam fatigue machine, a fatigue strength of 248 MPa was measured at 10^8 cycles for smooth bars at zero mean load. As is typical of nonferrous alloys, U6Nb does not exhibit a fatigue endurance limit. Reductions in fatigue strength for notched bars and for mean loads of 276 MPa and 483 MPa (70 ksi) were also determined. The predominant sites for fatigue crack initiation were identified as niobium carbide and uranium oxide inclusion clusters and the distribution of these inclusions are presented. Fatigue crack propagation rates were measured in the near-threshold regime using compact tension specimens. The fatigue threshold for crack growth rates below 10^{-7} mm/cycle were measured at both R = 0.1, for which a fatigue threshold of 3.2 $MPa\sqrt{m}$ was measured, and for constant Kmax cycles with Kmax values of 14.6 $MPa\sqrt{m}$ and 30.5 $MPa\sqrt{m}$, for which the fatigue threshold was reduced to 0.9 $MPa\sqrt{}$ and 0.6 $MPa\sqrt{m}$, respectively.

21969 (WAPD-T–3034) **Irradiation assisted stress corrosion cracking of HTH Alloy X-750 and Alloy 625.** Mills, W.J.; Lebo, M.R.; Bajaj, R.; Kearns, J.J.; Hoffman, R.C.; Korinko, J.J. Westinghouse Electric Corp., West Mifflin, PA (United States). Bettis Atomic Power Lab.; Bettis Atomic Power Lab., Pittsburgh, PA (United States). [1994]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-93PN38195 ; AC11-89PN38014. (CONF-9403119–1: 1994 meeting of the International Collaborative Group on Irradiation-Assisted Stress Corrosion Cracking (ICGIASCC), Stevenson, WA (United States), 30 Mar - 1 apr 1994). Order Number DE94012667. Source: OSTI; NTIS; INIS; GPO Dep.

In-reactor testing of bolt-loaded precracked compact tension specimens was performed in 360°C water to determine effect of irradiation on the SCC behavior of HTH Alloy X-750 and direct aged Alloy 625. Out-of-flux and autoclave control specimens provided baseline data. Primary test variables were stress intensity factor,

fluence, chemistry, processing history, prestrain. Results for the first series of experiments were presented at a previous conference. Data from two more recent experiments are compared with previous results; they confirm that high irradiation levels significantly reduce SCC resistance in HTH Alloy X-750. Heat-to-heat differences in IASCC were related to differences in boron content, with low boron heats showing improved SCC resistance. The in-reactor SCC performance of Alloy 625 was superior to that for Alloy X-750, as no cracking was observed in any Alloy 625 specimens even though they were tested at very high K_1 and fluence levels. A preliminary SCC usage model developed for Alloy X-750 indicates that in-reactor creep processes, which relax stresses but also increase crack tip strain rates, and radiolysis effects accelerate SCC. Hence, in-reactor SCC damage under high flux conditions may be more severe than that associated with postirradiation tests. In addition, preliminary mechanism studies were performed to determine the cause of IASCC in Alloy X-750.

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Refer also to citation(s) 20811, 20814, 20817, 21036, 21535, 21945, 22029, 22047, 22059, 23179, 23198

21970 (ANL/ET/CP–81946) **Melt-processing of Y-Ba-Cu-O superconductors for improved levitation.** Balachandran, U.; Zhong, W.; Emerson, J.E.; McDaniel, R.L. Argonne National Lab., IL (United States). Apr 1994. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940651–4: International workshop on superconductivity: critical current of high-temperature superconductors and related topics, Kyoto (Japan), 6-9 Jun 1994). Order Number DE94011503. Source: OSTI; NTIS; GPO Dep.

Melt processed bulk $YBa_2Cu_3O_{7-\delta}$ (YBCO) superconductors are of considerable interest in the application of low-friction, superconducting permanent magnet bearings and flywheel-energy-storage devices. The mechanisms of enhanced flux pinning in the melt processed samples has been the subject of many investigations. Fine precipitates of Y_2BaCuO_5 (211) are considered potential flux-pinning sites by many investigators. Several groups have reported the refinement of 211 precipitates through Pt additions. In this paper, the authors describe the melt processing of YBCO with additives such as 211, Pt, and Ag. Large single domain regions are obtained using small $SmBa2Cu3O_{7-\delta}$ (Sm-123) single crystal seeds. The microstructure and levitation forces are measured and reported here.

21971 (ANL/MSD/CP–82754) **Quadrupolar effects in $PrCu_2Si_2$.** Osborn, R. (Argonne National Lab., IL (United States)); Goremychkin, E.A. Argonne National Lab., IL (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940629–4: 6. joint conference on magnetism and magnetic materials, Albuquerque, NM (United States), 20-23 Jun 1994). Order Number DE94011509. Source: OSTI; NTIS; INIS; GPO Dep.

As part of a systematic study of the crystal field (CF) potential in RCu_2Si_2 compounds (R = Ce, Pr, Nd, Tb, Ho, Er) using inelastic neutron scattering, we have determined the CF level scheme and potential in the antiferromagnet $PrCu_2Si_2$ both above and below T_N. There have been recent speculations that the quadrupole moment of $PrCu_2Si_2$ has been quenched by the quadrupolar Kondo effect. Using the CF potential derived from our results, we have calculated the quadrupole moment Q_2 of $PrCu_2Si_2$ and compared it to the other members of the RCu_2Si_2 series. The temperature dependence of the quadrupole moment of $PrCu_2Si_2$ is significantly weaker-than all the other compounds eg. it is approximately five times smaller than $HoCu_2Si_2$. Therefore, it is the CF potential which is responsible for quenching Q_2 at low temperature rather than a quadrupolar Kondo effect. Furthermore, the CF Schottky contribution to $C/T \nu T^2$ is approximately linear above T_N and explains the anomalously high linear term in the specific heat. However, the evolution of the CF potential across the rare earth series provides evidence of an enhanced hybridization contribution to the CF potential of $PrCu_2Si_2$, intermediate between the heavy fermion $CeCu_2Si_2$ and the other rare earth compounds.

21972 (ANL/MSD/CP–83112) **Surface currents and bulk pinning in $Bi_2Sr_2CaCu_2O_8$.** Majer, D. (Weizmann Inst. of Science, Rehovoth (Israel)); Zeldov, E.; Konczykowski, M.; Geshkenbein, V.B.; Larkin, A.I.; Burlachkov, L.; Vinokur, V.M. Argonne National Lab., IL (United States). May 1994. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940701–4: Meeting on materials and mechanisms of superconductivity: high temperature superconductors, Grenoble (France), 4-9 Jul 1994). Order Number DE94013873. Source: OSTI; NTIS; GPO Dep.

The mechanisms giving rise to the irreversibility line (IL) in the phase diagram of $Bi_2Sr_2CaCu_2O_8$ and the mechanism behind the second maximum in the magnetization loops were determined using a novel Hall-sensor array. The IL is caused by bulk pinning at lower temperatures and by irreversible shielding currents above 22K. The second maximum is caused by vortex lattice melting, taking place at the same local magnetic induction B_m throughout the sample.

21973 (ANL/MSD/PP–73932) **Interband transitions in $YBa_2Cu_3O_7$.** Kircher, J. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (Germany)); Humlicek, J.; Garriga, M.; Cardona, M.; Fuchs, D.; Habermeier, H.U.; Fang, Y.; Welp, U.; Vandervoort, K.; Crabtree, G. Argonne National Lab., IL (United States). Aug 1991. 32p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract STC-8809854. Order Number DE94013338. Source: OSTI; NTIS; GPO Dep.

Using rotating analyzer ellipsometry, we have measured all three components of the dielectric tensor of $YBa_2CU_3O_7$ from near-infrared to vacuum-ultraviolet (0.7 – 24 eV). In the low energy region the spectra for a – b polarization can be well modelled by a Drude free-carrier response with a frequency independent scattering rate. Below 10 eV we observe strongly anisotropic interband transitions involving the partially filled valence band and the conduction band. At higher energies the anisotropy becomes smaller. In that region we see two prominent double structures around 16 eV and 20 eV that we assign to transitions from lower lying bands with O s and Ba p character to states dose to the Fermi level.

21974 (ANL/MSD/PP–77623) **Signature of the CuO_2 plane related bands in $YBa_2Cu_3O_{6.9}$ as seen by angle-resolved photoemission.** Lindroos, M. (Northeastern Univ., Boston, MA (United States). Physics Dept.); Bansil, A.; Gofron, K.; Campuzano, J.C.; Ding, H.; Liu, R. Argonne National Lab., IL (United States). Materials Science Div.; Northeastern Univ., Boston, MA (United States). Dept. of Physics. Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant DMR8914120; Contract DMR-8809854. Order Number DE94013297. Source: OSTI; NTIS; GPO Dep.

The authors present first-principles computations together with corresponding angle-resolved photoemission measurements in order to delineate the shape and polarization dependence of the spectral feature associated with the CuO_2 plane-related bands from the (001) surface of $YBa_2Cu_3O_{6.9}$. Theoretical predictions are found to be in remarkable agreement with the observed character of the spectral feature between 0 and 0.3 eV binding energy (for $k_{\|}$ values along the Γ-S line), and indicate that the local-density-approximation based wave-functions implicit in the theory provide a reasonable description of the CuO_2 plane band states near the Fermi energy. The computations also show that of the six possible surface terminations, the ARPES spectra from Y123(001) surface are reasonably described by the BaO/CuO_2 ideal surface termination, i.e. by assuming a BaO layer followed by a CuO_2 plane layer below.

21975 (ANL/MSD/PP–78611) **Low angle resistivity anomaly in layered superconductors.** Koshelev, A.E. (Leiden Univ. (Netherlands). Kamerlingh Onnes Lab.); Vinokur, V.M. Argonne National Lab., IL (United States). Jan 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013392. Source: OSTI; NTIS; INIS; GPO Dep.

The pinning effect of vortex lines by the layered structure (intrinsic pinning) on resistivity of high-T_c, superconductors in the mixed state is investigated by means of perturbation theory. A sharp drop in the resistivity at small angles for which vortex lines are almost aligned with the ab-planes is shown to occur even in a high-temperature region where the pinning potential is reduced by thermal fluctuations.

21976 (ANL/MSD/PP–78801) **$TlBa_2CaCu_2O_x$ epitaxial films: irreversibility, 2-D pinning, and critical currents.** Hettinger, J.D. (Argonne National Lab., IL (United States)); Miller, D.J.; Gray, K.E.; Kim, D.H.; DeLuca, J.; Karas, P.; Tkaczyk, J.E.; Eddy, M. Argonne National Lab., IL (United States). Jan 1993. 11p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DMR-91-20000(DHK). Order Number DE94013433. Source: OSTI; NTIS; GPO Dep.

Post-annealed epitaxial thin films of $TlBa_2CaCu_2O_x$ (Tl-1212) have been fabricated using sputtered precursors. Values of the transport critical current (J_c) for Tl-1212 epitaxial thin films in magnetic fields up to 7 tesla and at temperatures ranging from 25 to 77K are reported. These values are compared with those for Tl-2212 epitaxial films, Tl-2212 polycrystalline films, and Tl-1223 polycrystalline duck films. This comparison explicitly demonstrates the roles of grain boundaries and anisotropy in limiting the transport J_c. Analysis also supports the existence of a universal pinning defect in every highly anisotropic high-temperature superconductor, with a lower bound on the size of the defect being approximately 12Å in diameter.

21977 (BNL–60381) **Preliminary soft x-ray studies of beta-SiC.** Shek, M.L. (Brookhaven National Lab., Upton, NY (United States)); Miyano, K.E.; Ederer, D.L.; Dong, Q.Y.; Callcott, T.A. Brookhaven National Lab., Upton, NY (United States). [1994]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9311104–21: 40. national symposium of the American Vacuum Society (AVS), Orlando, FL (United States), 15-19 Nov 1993). Order Number DE94013023. Source: OSTI; NTIS; GPO Dep.

We have looked at beta-SiC with soft x-ray emission and photoemission spectroscopy. From the Si L_{23} and C K emissions, the Si s+d-like and C p partial density of states in the bulk valence band are identified, and compared with valence band photoemission. In addition to bulk electronic structural features, photoemission from a (3 x 2) Si-rich surface shows two surface-derived valence features at ~ -2.6 and ~ -1.6 eV relative to the Fermi level. The intensities of these valence features vary as those of surface Si 2p core level components shifted by -0.5 eV and -1.4 eV from the bulk-like SiC Si 2p core level. We have also used the Si L_{23} absorption edge as a probe of the unfilled states near the conduction, band minimum.

21978 (CONF-940753–12) **EELS of colloids in Mg^+ implanted $MgAl_2O_4$ spinel.** Evans, N.D. (Oak Ridge Inst. for Science and Education, TN (United States)); Zinkle, S.J. Oak Ridge National Lab., TN (United States); Oak Ridge Inst. for Science and Education, TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; AC05-76OR00033. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012756. Source: OSTI; NTIS; GPO Dep.

During 2-MeV Mg^+ implantation at 25 C to $2.8 \times 10^{21}/m^2$, dislocation loops are formed at midrange depths (0.5-1.0μm) on {110} and {111}. No evidence was found for the dark field images to be hexagonal metallic Mg; the colloids are suggested to be either metallic Al or another phase coherent with surrounding spinel. Regression analysis of low-loss spectra and diffraction data are consistent with the colloids in the implanted ion region being metallic Al, although the colloids could be metallic Mg in a metastable cubic structure.

21979 (CONF-940753–21) **Surface roughness characterization of various ceramic fibers using AFM and low voltage SEM.** More, K.L.; Lara-Curzio, E.; Lowden, R.A. Oak Ridge National Lab., TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94013635. Source: OSTI; NTIS; GPO Dep.

Effect of interfacial properties in fiber-reinforced ceramic matrix composites is critical to overall mechanical behavior of the composite. In this study, the surfaces of several ceramic fibers (Nicalon SiC, Nextel aluminosilicate) were studied qualitatively using a FEG SEM at low voltages and quantitatively using AFM. Nicalon fibers had a Ra (arithmetic mean of absolute values of departure of roughness profile from mean line) of 3.4 nm over several line scans, 3.9 nm from area analysis. Nextel fibers, which are oval, are slightly rougher than Nicalon and have an average Ra of 4.8 nm from several line profiles. Grooves ran the entire length of the Nextel fibers. 5 figs, 5 refs.

21980 (DOE/ER/12103–3) **Positron studies in catalysis research: Progress report, September 1993–April 1994, and final report, 15 January 1990–14 January 1994.** Michigan Univ., Ann Arbor, MI (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER12103. Order Number DE94012793. Source: OSTI; NTIS; INIS; GPO Dep.

During the past eight months, the authors have made progress in several areas relevant to the eventual use of positron techniques in catalysis research. They have come closer to the completion of their positron microscope, and at the same time have performed several studies in their non-microscopic positron spectrometer which should ultimately be applicable to catalysis. The current status of the efforts in each of these areas is summarized in the following sections: Construction of the positron microscope (optical element construction, data collection software, and electronic subassemblies); Doppler broadening spectroscopy of metal silicide; Positron lifetime spectroscopy of glassy polymers; and Positron lifetime measurements of pore-sizes in zeolites.

21981 (DOE/ER/45157–T2) **A study of mechanical processing damage in brittle materials: Progress report, 1 August 1984–28 February 1985.** Khuri-Yakub, B.T. Stanford Univ., CA (United States). Edward L. Ginzton Lab. Apr 1985. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-84ER45157. Order Number DE94012345. Source: OSTI; NTIS; GPO Dep.

The authors are continuing their work on developing the necessary methods for the nondestructive evaluation of machining damage in structural ceramics. Machining operations such as grinding, cutting, and polishing induce slot-like cracks in ceramic materials and lead to a marked decrease in their strength. The presence of compressive surface residual stress, which is responsible for crack mouth closure, leads to slow crack growth and a further reduction in strength. They are continuing the study of the effect of single isolated cracks and have just begun to look at the problem of multiple cracks due to grinding damage. In the last reporting period, the authors studied the effect of isolated cracks on the strength of ceramic components. They used a pulse-echo acoustic technique to measure the scattering coefficient of the crack to surface acoustic waves as a function of frequency. In the presence of compressive surface residual stress, the cracks are closed at the surface and their scattering coefficient exhibits a characteristic null that allows for the determination of the crack depth using the acoustic pulse-echo technique. Thus, they find it possible to evaluate the crack sizes in the seeded samples, and the reduction in strength engendered with very good accuracy. The authors are presently in the middle of a study of a set of twelve samples with isolated seeded cracks. Plans for further studies are described.

21982 (DOE/ER/45157–T3) **A study of mechanical processing damage in brittle materials: Progress report, 1 February 1986–31 October 1986.** Khuri-Yakub, B.T. Stanford Univ., CA (United States). Edward L. Ginzton Lab. Oct 1986. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-84ER45157. Order Number DE94012346. Source: OSTI; NTIS; GPO Dep.

Two major breakthroughs have occurred in the characterization of machining damage in structural ceramics. A technique has been developed to evaluate multiple machining cracks, and a method with excellent spatial resolution has been discovered for evaluating

surface residual stresses and anisotropy in materials. Using a combination of surface acoustic wave scattering and cepstral analysis of the frequency spectrum, the author can find the depth of the deepest crack in a group of 4 or 5 cracks. The method was tested with several samples with machining type cracks. The author also invented a new type of acoustic microscope lens that uses shear instead of longitudinally-polarized transducers. The paper discusses its application to this study.

21983 (DOE/ER/45157–T5) **A study of mechanical processing damage in brittle materials: Annual progress report, 1 April 1988–31 March 1989.** Khuri-Yakub, B.T. Stanford Univ., CA (United States). Edward L. Ginzton Lab. Apr 1989. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-84ER45157. Order Number DE94012348. Source: OSTI; NTIS; GPO Dep.

The first project deals with examining ceramics when they are in the green state, and evaluating the effect of density and mechanical property variations on the final hot-pressed parts. The second aspect of the project deals with the direct characterization of surface and near-surface defects that are induced by machining operations. For the ultrasonic inspection of green ceramics, it is necessary to introduce ultrasound in the sample without immersing it in water. The author's approach is to develop air transducers based on using new types of matching layers. The paper describes the development of these air transducers. The work on the characterization of machining damage in ceramics considered the special problem of ball bearings. Ball bearings may be the first wide-range industrial application for hot-pressed ceramic materials. The major problem with the ball bearings is their sensitivity to small surface and near-surface defects. Presently, inspection is performed by optical microscopy. The author developed an amplitude and phase acoustic microscopy method and constructed a special fixture to rotate the ball bearings under a focused transducer.

21984 (DOE/ER/45320–6) **Studies of the III-V compounds in the megabar regime: Annual technical progress report.** Ruoff, A.L. Cornell Univ., Ithaca, NY (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45320. Order Number DE94012488. Source: OSTI; NTIS; GPO Dep.

In this project the authors develop techniques for making high pressure measurements (x-ray diffraction and optical measurements) on samples in the multimegabar regime and they make systematic studies of the crystal structure of III-V compounds and other materials as a function of pressure with the broad objective of providing experimental data over a broad range of coordination number and interatomic spacing which can play a leading role in the testing and development of theoretical models of binding. They also create new materials. It was shown that all the compounds AlN, GaN and InN transform to the C1-type structure with AlN remaining as 100% rocksalt structure on release of pressure. Various parameters in the equation of state (EOS) were measured. The EOS of BP was measured to 110 GPa but no phase transitions were seen. AlAs was shown to transform from the initial zincblende phase to the nickel arsenide phase, the first case of this in the IV-V compounds. The first experiments on CdTe were carried to 51 GPa and are now being analyzed.

21985 (DOE/ER/45391–T1) **Theory of the electronic and structural properties of solid state oxides: Progress report, [July 1, 1991–June 30, 1992].** Chelikowsky, J.R. Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science. Oct 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45391. Order Number DE94013704. Source: OSTI; NTIS; GPO Dep.

Emphasis was on the electronic materials silica and titania, with interest centered on their microstructure in the amorphous/glassy state. Techniques are based on ab initio pseudopotential methods and interatomic potentials. Areas examined included the amorphization of quartz under pressure, equation of state of crystalline silica polymorphs, optical and electronic properties of quartz under pressure, optical and structural properties of titania, and new theoretical approaches to covalent bonds in oxides and small clusters (buckminsterfullerene, etc.)

21986 (DOE/ER/45391–T2) **Theory of the electronic and structural properties of solid state oxides: Progress report, [July 1, 1992–June 30, 1993].** Chelikowsky, J.R. Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science. Jan 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45391. Order Number DE94013705. Source: OSTI; NTIS; GPO Dep.

Some areas examined are: (1) The nature of the amorphization process of quartz under pressure, including the development of a new microscopic model for the amorphization process. (2) Elastic anomalies in high temperature forms of silica, including the discovery of a negative Poisson ratio in α-cristobalite. (3) The equation of states of crystalline silica polymorphs. (4) The behavior of the optical and electronic properties of quartz under pressure. (5) The optical and structural properties of titania and ruthenia. (6) The nature of transition metal dopants in titania. (7) New theoretical approaches for understanding covalent bonds in oxides and small semiconductor clusters.

21987 (DOE/ER/45427–4) **Midwest superconductivity consortium: 1993 Progress report.** Purdue Univ., Lafayette, IN (United States). Jan 1994. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45427. Order Number DE94012716. Source: OSTI; NTIS; GPO Dep.

The Midwest Superconductivity Consortium, MISCON, in the fourth year of operations further strengthened its mission to advance the science and understanding of high T_c superconductivity. The goals of the organization and the individual projects continue to reflect the current needs for new knowledge in the field and the unique capabilities of the institutions involved. Group efforts and cooperative laboratory interactions to achieve the greatest possible synergy under the Consortium continue to be emphasized. Industrial affiliations coupled with technology transfer initiatives were expanded. Activities of the participants during the past year achieved an interactive and high level of performance. The number of notable achievements in the field contributed by Consortium investigators increased. The programmatic research continues to focus upon key materials-related problems in two areas. The first area has a focus upon "Synthesis and Processing" while the second is centered around "Limiting Features in Transport Properties of High T_c Materials".

21988 (DOE/OR/22041–2) **Densification of nano-size powders: 1994 report.** Chen, W. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)); Malghan, S.G.; Dapkunas, J.S.; Piermarini, G.; Pechenik, A.; Danforth, S.C. National Inst. of Standards and Technology, Gaithersburg, MD (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-92OR22041. Order Number DE94013486. Source: OSTI; NTIS; GPO Dep.

Green compacts from a nano-size silicon nitride powder were fabricated having density up to 67% of theoretical at 2.8 GPa pressure using liquid nitrogen and pentane as compaction lubricant media. Pressureless sintering of these transparent samples did not promote further densification beyond that obtained for the green state. To further increase the density of these samples, a hot-pressing device was designed. In a series of experiments, hot-pressing of these samples at.0.5 to 1.0 GPa and 800 C, followed by pressureless sintering at 1400 C was studied. The resulting silicon nitride ceramic had a Vickers hardness of 9.0 GPa while transparency under visible light was maintained. Without the use of hot pressing, the hardness obtained was 5.8 GPa. In addition, the effect of compaction pressure on densification was studied for nano-size Al_2O_3 to further understand factors contributing to achieving high green densities. The dense Al_2O_3 green samples were pressureless sintered to near full density at temperatures several hundred degrees lower than those needed for sintering low density green material.

21989 (DOE/OR/22041–T1) **Equipment for investigation of cryogenic compaction of nanosize silicon nitride powders: 1993 report.** Chen, W. (National Inst. of Standards and Technology, Gaithersburg, MD (United States). Materials Science and Engineering Lab.); Piermarini, G.J.; Dapkunas, S.J.; Malghan, S.G.; Pechenik, A.; Danforth, S. National Inst. of Standards and Technology (IMSE), Gaithersburg, MD (United States). [1993]. 11p.

Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-92OR22041. Order Number DE94013593. Source: OSTI; NTIS; GPO Dep.

This paper describes a highly-specialized system for studies of time-dependent compaction of nanosize silicon nitride powders under a variety of atmospheres and at temperatures ranging from 77 to 1,000 K. The system incorporate's a screw-driven press (10 ton capacity) with a piston-cylinder type die and can produce decylindrical powder compacts, 3 mm in diameter and approximately 1 mm in thickness, using pressures up to 3 GPa. The system is computer-controlled and permits accurate measurements of the sample volume, and, after appropriate calibration, can determine the rate and degree of densification of the compacting powder as pressure is applied. Frictional forces between the piston and the die are measured during the compaction process. For calibration of the system, powders with known volume-change accompanied by phase transition under pressure were studied, and good agreement with published results was demonstrated. Several Si_3N_4 samples have been compacted and sintered at 1,300 to 1,600 C. A maximum random packing density of 64% has been obtained using liquid nitrogen as a lubricant medium at pressure lower than 2.5 GPa. Both green samples and sample sintered at temperatures to 1,500 C exhibited visual transparency under visible light.

21990 (ENEA-RT-INN–93-14) **Preparation and electrical characterization of ceramic material for energy applications.** Alessandrini, F. (ENEA, Casaccia (Italy). Area Energia e Innovazione); Alvani, C.; Casadio, S.; De Logu, P.; Dikonimos Makris, T.; Masci, A.; Nannetti, C.A.; Petrucci, L. ENEA, Casaccia (Italy). Area Energia e Innovazione. Nov 1993. 12p. (RT/INN–93-14). Order Number DE94775311. Source: OSTI; NTIS (US Sales Only).

Ceramic oxides such as lithium aluminate, lithium zirconate, Y-doped zirconia and Sr-doped lanthanum manganite were prepared and characterized in terms of electric conductivity, a property related to their use in critical functional components of advanced energy converters, e.g., solid oxide fuel cell.

21991 (HW–81876) **DT-IP-434-D: Irradiation effect on ceramic materials.** Cooley, D.E. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Apr 1964. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010539. Source: OSTI; NTIS; GPO Dep.

Declassified.

The purpose of the test described in this report was to determine the effect of production reactor flux on ceramic materials being considered for lining the vertical safety rod channels at the production reactors. This document is being written to describe the test, the results to date, and the work which remains to be done. The materials being evaluated in the test are: Aluminum silicate (Maryland Lava Co.); silicon nitride bonded silicon carbide (Norton Co. "crystalon"); and aluminum oxide 85% (Norton Co. "Alundum RA-98").

21992 (INIS-mf–13808, pp. 106) **Rare earth magnetism in $RBaSrCu_3O_{7-x}$ (R=Gd,Pr).** Hilscher, G. (Technische Univ., Vienna (Austria). 2. Inst. fuer Experimentalphysik); Holubar, T.; Schaudy, G.; Wortmann, G.; Strecker, M.; Wang, X.Z.; Hellebrand, B.; Baeuerle, D. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GADOLINIUM COMPOUNDS/magnetic susceptibility; PRASEODYMIUM COMPOUNDS/magnetic susceptibility; STRONTIUM COMPOUNDS/magnetic susceptibility; ANTIFERROMAGNETISM; BARIUM COMPOUNDS; CRYSTAL STRUCTURE; CUPRATES; HIGH-TC SUPERCONDUCTORS; MOESSBAUER EFFECT; SPECIFIC HEAT; SUPERCONDUCTIVITY

21993 (INIS-mf–13808, pp. 107) **Magnetism and superconductivity in $Sr_2R_{1-x}Ce_xMCu_2O_{8+\delta}$.** Hilscher, G. (Technische Univ., Vienna (Austria). 2. Inst. fuer Experimentalphysik); Holubar, T.; Kirchmayr, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CERIUM COMPOUNDS/magnetism; CERIUM COMPOUNDS/superconductivity; EUROPIUM COMPOUNDS/magnetism; EUROPIUM COMPOUNDS/superconductivity; GADOLINIUM COMPOUNDS/magnetism; GADOLINIUM COMPOUNDS/superconductivity; NEODYMIUM COMPOUNDS/magnetism; NEODYMIUM COMPOUNDS/superconductivity; NIOBIUM COMPOUNDS/magnetism; NIOBIUM COMPOUNDS/superconductivity; PRASEODYMIUM COMPOUNDS/magnetism; PRASEODYMIUM COMPOUNDS/superconductivity; SAMARIUM COMPOUNDS/magnetism; SAMARIUM COMPOUNDS/superconductivity; STRONTIUM COMPOUNDS/magnetism; STRONTIUM COMPOUNDS/superconductivity; TANTALUM COMPOUNDS/magnetism; TANTALUM COMPOUNDS/superconductivity; MAGNETISM; SUPERCONDUCTIVITY; CONCENTRATION RATIO; CRYSTAL STRUCTURE; CUPRATES; HIGH-TC SUPERCONDUCTORS

21994 (INIS-mf–13808, pp. 109) **Preparation of superconducting Bi-Sr-Ca-Cu-O films on silver ribbons with buffer top coating.** Gruber, H. (Technische Univ., Graz (Austria). Inst. fuer Festkoerperphysik); Krautz, E.; Fritzer, H.P.; Popitsch, A. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/bismuth compounds; CUPRATES/calcium compounds; CUPRATES/strontium compounds; CUPRATES; HIGH-TC SUPERCONDUCTORS; SAMPLE PREPARATION; THIN FILMS; TRANSITION TEMPERATURE

21995 (INIS-mf–13808, pp. 109) **Optical and electrical investigations on $Pr_xY_{1-x}Ba_2Cu_3O_{7-\delta}$ crystals.** Holzinger-Schweiger, E. (Technische Univ., Graz (Austria). Inst. fuer Festkoerperphysik); Leising, G.; Poelt, P. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/barium compounds; CUPRATES/praseodymium compounds; CUPRATES/yttrium compounds; CRYSTAL GROWTH; CUPRATES; ELECTRIC CONDUCTIVITY; REFLECTIVITY; TEMPERATURE DEPENDENCE

21996 (INIS-mf–13808, pp. 110) **Pressure- and magnetic-field dependence of electric resistance of cubic $YbCu_1T$ compounds (T=Au, Ag, Pd).** Hauser, R. (Inst. fuer Experimentalphysik, Technische Univ. Vienna, Vienna (Austria)); Bauer, E.; Gratz, E.; Tuan, L.; Maikis, M.; Indinger, A.; Kottar, A.; Oomi, G.; Kagayama, T. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. YTTERBIUM ALLOYS/magnetic fields; YTTERBIUM ALLOYS/pressure dependence; COPPER ALLOYS; ELECTRIC CONDUCTIVITY; GOLD ALLOYS; HIGH-TC SUPERCONDUCTORS; INTERMETALLIC COMPOUNDS; PALLADIUM ALLOYS; SILVER ALLOYS; TEMPERATURE DEPENDENCE

21997 (INIS-mf–13808, pp. 112) **High-current investigations of flux tube pinning energy in YBaCuO.** Fussenegger, C. (Ludwig Boltzmann Inst. fuer Festkoerperphysik, Vienna (Austria)); Lang, W.; Schwab, P.; Wang, X.Z.; Baeuerle, D. Oesterreichische

Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/barium compounds; CUPRATES/yttrium compounds; CUPRATES; CURRENT DENSITY; ELECTRIC CONDUCTIVITY; MAGNETIC FLUX; THIN FILMS

21998 (INIS-mf–13808, pp. 113) **Superconducting fluctuations in 2223-BISrCaCuO films with high anisotropy.** Lang, W. (Vienna Univ. (Austria). Inst. fuer Festkoerperphysik); Kula, W.; Sobolewski, R. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/bismuth compounds; CUPRATES/calcium compounds; CUPRATES/strontium compounds; SUPERCONDUCTIVITY/fluctuations; ANISOTROPY; CUPRATES; FILMS; SUPERCONDUCTIVITY; FLUCTUATIONS

21999 (INIS-mf–13808, pp. 118) **Micro-Raman measurements over a wide spectral range on an $YBa_2Cu_3O_{7-y}$ single crystal.** Mayer, M. (Inst. fuer Experimentalphysik, Univ. Graz, Graz (Austria)); Pressl, M.; Lo, S.; Knoll, P.; Holzinger-Schweiger, E. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/barium compounds; CUPRATES/yttrium compounds; CUPRATES; HIGH-TC SUPERCONDUCTORS; POLARIZED BEAMS; RAMAN SPECTRA

22000 (INIS-mf–13808, pp. 118) **Lattice-dynamic potential of the apex oxygen in $YBa_2Cu_3O_7$.** Ambrosch-Draxl, C. (Inst. fuer Theoretische Physik, Univ. Graz, Graz (Austria)); Knoll, P. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. YTTRIUM COMPOUNDS/lattice vibrations; BAND THEORY; BARIUM COMPOUNDS; CUPRATES; OXYGEN; POTENTIALS

22001 (LA-UR–94-1657) **Structural ground-state of La_2CuO_4 in the LTO phase: Evidence of local disorder.** Billinge, S.J.L. (Los Alamos National Lab., NM (United States)); Kwei, G.H.; Takagi, H. Los Alamos National Lab., NM (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940701–2: Meeting on materials and mechanisms of superconductivity: high temperature superconductors, Grenoble (France), 4-9 Jul 1994). Order Number DE94013126. Source: OSTI; NTIS; GPO Dep.

We present neutron scattering data which indicate that the local structure of La_2CuO_4 in the LTO phase is disordered. Data from two different diffractometers are compared and systematic differences between the pair distribution functions (PDF) of the LTO model and the data are reproduced in both cases.

22002 (LA-UR–94-1729) **Cation disorder in high dose neutron irradiated spinel.** Sickafus, K.E. (Los Alamos National Lab., NM (United States)); Larson, A.C.; Yu, N.; Nastasi, M.; Hollenberg, G.W.; Garner, F.A.; Bradt, R.C. Los Alamos National Lab., NM (United States). [1994]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940416–10: 96. annual meeting of the American Ceramic Society, Indianapolis, IN (United States), 24-28 Apr 1994). Order Number DE94013118. Source: OSTI; NTIS; INIS; GPO Dep.

The crystal structures of $MgAl_2O_4$ spinel single crystals irradiated to high neutron fluences ($>5{\cdot}10^{26}$ n/m^2 ($E_n>0.1$ MeV)), were examined by neutron diffraction. Crystal structure refinement of the highest dose sample indicated that the average scattering strength of the tetrahedral crystal sites decreased by ~20% while increasing by ~8% on octahedral sites. Since the neutron scattering length for Mg is considerably larger than for Al, this result is consistent with site exchange between Mg^{2+} ions on tetrahedral sites and Al^{3+} ions on octahedral sites. Least squares refinements also indicated that in all irradiated samples, at least 35% of Mg^{2+} and Al^{3+} ions in the crystal experienced disordering replacements. This retained dpa on the cation sublattices is the largest retained damage ever measured in an irradiated spinel material.

22003 (LA-UR–94-1733) **Low temperature atmospheric pressure chemical vapor deposition of group 14 oxide films.** Hoffman, D.M. (Houston Univ., TX (United States)); Atagi, L.M.; Chu, Wei-Kan; Liu, Jia-Rui; Zheng, Zongshuang; Rubiano, R.R.; Springer, R.W.; Smith, D.C. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States);Texas State Government, Austin, TX (United States);Welch (Robert A.) Foundation, Houston, TX (United States);Sloan (Alfred P.) Foundation, New York, NY (United States). DOE Contract W-7405-ENG-36. (CONF-940411–24: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013115. Source: OSTI; NTIS; GPO Dep.

Depositions of high quality SiO_2 and SnO_2 films from the reaction of homoleptic amido precursors $M(NMe_2)4$ (M = Si,Sn) and oxygen were carried out in an atmospheric pressure chemical vapor deposition r. The films were deposited on silicon, glass and quartz substrates at temperatures of 250 to 450C. The silicon dioxide films are stoichiometric (O/Si = 2.0) with less than 0.2 atom % C and 0.3 atom % N and have hydrogen contents of 9 ± 5 atom %. They are deposited with growth rates from 380 to 900 Å/min. The refractive indexes of the SiO_2 films are 1.46, and infrared spectra show a possible Si-OH peak at 950 cm^{-1}. X-Ray diffraction studies reveal that the SiO_2 film deposited at 350C is amorphous. The tin oxide films are stoichiometric (O/Sn = 2.0) and contain less than 0.8 atom % carbon, and 0.3 atom % N. No hydrogen was detected by elastic recoil spectroscopy. The band gap for the SnO_2 films, as estimated from transmission spectra, is 3.9 eV. The resistivities of the tin oxide films are in the range 10^{-2} to 10^{-3} Ωcm and do not vary significantly with deposition temperature. The tin oxide film deposited at 350C is cassitterite with some (101) orientation.

22004 (ORNL/HTSPC–5) **ORNL superconducting technology program for electric power systems: Annual report for FY 1993.** Hawsey, R.A. (comp.). Oak Ridge National Lab., TN (United States). Apr 1994. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94011471. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge National Laboratory (ORNL) Superconducting Technology Program is conducted as part of a national effort by the US Department of Energy's Office of Energy Efficiency and Renewable Energy to develop the technology base needed by US industry for commercial development of electric power applications of high-temperature superconductivity. The two major elements of this program are conductor development and applications development. This document describes the major research and development activities for this program together with related accomplishments. The technical progress reported was summarized from information prepared for the FY 1993 Annual Program Review held July 28–29, 1993. This ORNL program is highly leveraged by the staff and other resources of US industry and universities. In fact, nearly three-fourths of the ORNL effort is devoted to industrial competitiveness projects with private companies. Interlaboratory teams are also in place on a number of industry-driven projects. Patent disclosures, working group meetings, staff exchanges, and joint publications and presentations ensure that there is technology transfer to US industry. Working together, the collaborative teams are making rapid progress in solving the scientific and technical

issues necessary for the commercialization of long lengths of practical high-temperature superconductor wire and wire products.

22005 (SAND–94-1430C) **Paramagnetic point defects in amorphous thin films of SiO_2 and Si_3N_4: An update.** Poindexter, E.H. (Army Research Lab., Fort Monmouth, NJ (United States)); Warren, W.L. Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940529–13: 185. Electrochemical Society meeting, San Francisco, CA (United States), 22-27 May 1994). Order Number DE94013769. Source: OSTI; NTIS; GPO Dep.

Recent research on point defects in thin films of SiO_2 and Si_3SN_4 on Si is presented and reviewed. In SiO_2 it is now clear that no one type of E′ center is the sole source of radiation-induced positive charge; hydrogenous moieties or other types of E′ are proposed. Molecular orbital theory and easy passivation of E′ by H_2 suggest that released H might depassivate P_b sites. A charged E'_δ center has been seen in Cl-free SIMOX and thermal oxide film, and it is reassigned to an electron delocalized over four $O_3{\equiv}Si$ units around a fifth Si. In Si_3N_4 a new model for the amphoteric charging of $Si{\equiv}N_3$ moieties is based on local shifts in defect energy with respect to the Fermi level, arising from nonuniform composition; it does not assume negative-U electron correlation. A new defect NN_2^0 has been identified, with dangling orbital on a 2-coordinated N atom bonded to another N.

3606 Other Materials

Refer also to citation(s) 20768, 20851, 20852, 20853, 20907, 20966, 20967, 20969, 21407, 21408, 21411, 21502, 21648, 21836, 21841, 21875, 21929, 21979, 21984, 21989, 21993, 21994, 22088, 22093, 22094, 22096, 22229, 22248, 22347, 22351, 22420, 22421, 23199, 23291, 23298

22006 (ANL/CHM/CP–81275) **Time-of-flight pulsed ion beam surface analysis as a means of in situ, real-time characterization of the growth of ferro-electric and conductive oxide heterostructures.** Krauss, A.R. (Argonne National Lab., IL (United States)); Gruen, D.M.; Auciello, O.; Lin, Y.; Chang, R.P.H. Argonne National Lab., IL (United States). Apr 1994. 13p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant N00014-93-1-0591. (CONF-9403120–1: 6. international symposium on integrated ferroelectrics, Monterey, CA (United States), 14-16 Mar 1994). Order Number DE94012628. Source: OSTI; NTIS; GPO Dep.

Pulsed beam Time-of-Flight Ion Scattering and Recoil Spectroscopy (TOF-ISARS) surface analysis methods have been developed which permit real-time, in situ characterization of the growth layer of multi-component oxide thin films. Results are presented from a study of the deposition of Pb, Zr, Ti and Ru using a sequential layer-by-layer deposition method under ambient oxygen pressure conditions appropriate to the growth of PZT films, revealing layer-by-layer as well as 2D and 3D island growth processes during deposition. Thermodynamic stability conditions result in modification of the layered structure, during deposition, in some cases altering the layer ordering of the growth region. Calculations using the Miedema model for surface segregation are in accord with experimental results that reveal an exchange between deposited Zr and Ti atoms and an underlying Pb layer. In addition, the room temperature studies revealed that Pb grows layer-by-layer, nucleating as 2D islands, while Zr tends to form three-dimensional islands. At room temperature, the Zr surface concentration is strongly enhanced by the presence of oxygen, but at high temperatures, surface Pb is found to be stabilized by the presence of an oxygen ambient, illustrating the importance of real-time, in situ analysis of the growth layer as opposed to more conventional surface analytical methods which require interruption of the deposition process in order to characterize the film surface.

22007 (ANL/CHM/CP–82961) **Turning soot into diamonds with microwaves.** Gruen, D.M. (Argonne National Lab., IL (United States)); Krauss, A.R.; Luo, J.; Pan, X.; Liu, S. Argonne National Lab., IL (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940782–1: 29. microwave power symposium, Chicago, IL (United States), 25-27 Jul 1994). Order Number DE94013426. Source: OSTI; NTIS; GPO Dep.

Growth of diamond films using fullerene precursors in an argon microwave plasma without the addition of hydrogen or oxygen has recently been accomplished. Microwave discharges (2.45 GHz) were generated in C_{60}-containing Ar. The gas mixtures were produced by flowing Ar over fullerene-containing soot at a variety of temperatures. Optical spectroscopy shows that the spectrum is dominated by the $d^3\Pi - a^3\Pi_u$. Swan bands of C_2 and particularly the $\Delta\nu = -2, -1.0, +1$, and $+2$ sequences, that C_2 is one of the products of C_{60} fragmentation brought about, at least in part, by collisionally-induced dissociation. The nanocrystalline films were characterized with scanning and high-resolution transmission electron microscopy, x-ray diffraction, and Raman spectroscopy. Assuming a linear dependence on carbon concentration, a growth rate at least six times higher than commonly observed using methane as a precursor would be predicted at a carbon content of 1% based on C_{60}. Energetic and mechanistic arguments are advanced to rationalize this result based on C_2 as the growth species.

22008 (ANL/ET/CP–82303) **Development of nondestructive evaluation methods and prediction of effects of flaws on the fracture behavior of structural ceramics.** Ellingson, W.A.; Singh, J.P.; Sivers, E.A.; Holloway, D.L.; Jacobs, T.D.; Dieckman, S.L.; Singh, D. Argonne National Lab., IL (United States). May 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405143–3: 8. annual conference on fossil energy materials, Oak Ridge, TN (United States), 10-12 May 1994). Order Number DE94012466. Source: OSTI; NTIS; GPO Dep.

In the NDE area, specimens with different cloth lay-up orientations were examined by a 3-D X-ray microtomography device and image processing to measure and map in-plane fiber orientations. Results show detection sensitivity to better than $\pm 3°$. We establish detection of 3-D braid/weave fiber orientation and spacing. Another NDE method, multinuclear (^{13}C,^{29}Si, and ^{11B} NMR spectroscopy, is being developed to determine the chemical state of the fiber surface and its potential impact on fiber pullout. We have conducted initial studies to investigate sensitivity to bulk composition of the matrix materials (a,b, amorphous phase, silica, and oxynitride concentration). The first ^{29}Si NMR experiments focused on methods to enhance the signal from the surface by selectively reducing surface relaxation. Additionally, we have determined that there is sufficient sensitivity of ^{11}B NMR for monitoring fiber coatings.

22009 (CONF-931269–, pp. 237-240) **Mechanical properties of silica aerogel.** Tajiri, K. (National Industrial Research Institute of Nagoya, Nagoya (Japan)); Igarashi, K.; Nishio, T. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The present report describes mechanical properties of silica aerogel. Tested aerogel was prepared by a method where starting material, methylsilicate (TMOS), was used to make wet gel, which was transformed into hydrophobic gel through aging in ethanol and supercritical drying and further into hydrophilic gel by being treated in the air. Bending test and compression test of samples were carried out to clarify the correlations of these properties with aging, heat treatment, density of wet gel, etc. The bending strength was calculated by the load at the time of fracture of the sample using a formula. The strength is proportional to density and increases also with aging. The effect of heat treatment is not clear. Its high values in small samples may be due to few defects included. Increase of strength by aging may be attributed to reinforcement of network structure. Compression strength was determined by applying loads

of 1-5kgf and used to evaluate the compression characteristics of gel by calculation. Compression strength is more than ten times larger than bending strength and increases as density increases. Its magnitude depends on the shape and size of samples. It is noticeable that samples undergo only plastic deformation by compression prior to heat treatment and is hardened without being blackened. 11 figs.

22010 (CONF-931269–, pp. 241-243) **Basic structure of silica aerogel.** Igarashi, K. (National Industrial Research Institute of Nagoya, Nagoya (Japan)); Tajiri, K.; Tanemura, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports the result of investigating the basic structure of silica aerogel by using a TG-DSC, small angle X-ray scattering, and Raman spectroscopy. The silica aerogel used as a test sample was prepared by aging a wet gel obtained by hydrolysis of tetramethoxysilane (TMOS) diluted with CH3OH in C2H5OH atmosphere, and then drying it under a super critical condition of C2H5OH. The paper describes the following matters: particles with grain size of about 2.5 nm and about 5 nm occupy 50% or more and 30% or more respectively of the whole silica aerogel; organic residues that have been coupled with SiO in such forms as SiO-CH3 and SiO-C2H5 exist (though they decompose at temperatures higher than 241°C), but it is hard to believe that OH groups are contained in silica aerogel; and Raman spectra of quartz glass and silica aerogel having been treated under 500°C for three hours resemble well with each other on the whole, but some Raman bands are recognized that suggest difference in the network structure of silica between both spectra. 5 figs.

22011 (CONF-931269–, pp. 245-248) **Preparation and thermochromism of V(1-x)WxO2 films deposited by dual-target sputtering.** Jin, P. (National Indsutrial Research Institute of Nagoya, Nagoya (Japan)); Yoshimura, K.; Tazawa, M.; Miki, T.; Igarashi, K.; Tanemura, S. Japan Solar Energy Society, Tokyo (Japan). 9 Dec 1993. 323p. (In Japanese). From 1993 JSES/JWEA Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy; Tsukuba (Japan); 9-10 Dec 1993. In *1993 JSES(Japan Solar Energy Society)JWEA(Japan Wind Energy Association) Joint Conference and '93 Japan-Korea Joint Conference on Solar Energy(December9and10,1993).* Order Number DE94767725. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

This paper reports fabrication of V(1-x)WxO2 films by using dual-target sputtering. A magnetron sputtering equipment having two targets for V and W was used to experiment forming of a VO2 film on a silicon substrate (at temperature from 300°C to 500°C) by introducing argon and oxygen at a predetermined flow rate. It was learned that it is necessary for forming a VO2 single phase film to control the oxygen flow ratio in a narrow range of around 2.7%. By varying the applied voltage to the W target, with the substrate temperature at 400°C and the oxygen flow ratio at 2.7%, a V(1-x)WxO2 film (x = 0% to 1.4%) was formed on the silicon substrate. It was made clear that addition of W at 1% by atomic weight can reduce the film transition temperature (67°C for the VO2 single phase film) by about 24°C, and that the V(1-x)WxO2 film formed on a glass substrate shows an excellent thermochromism little different from that in the VO2 film. 9 refs., 8 figs., 1 tab.

22012 (CONF-940135–6) **Some considerations for modeling the creep behavior of composite materials.** Lara-Curzio, E.; Ferber, M.K. Oak Ridge National Lab., TN (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 18. annual conference on composites and advanced ceramics; Cocoa Beach, FL (United States); 9-14 Jan 1994. Order Number DE94012112. Source: OSTI; NTIS; GPO Dep.

A simple treatment of the mechanics of creep in unidirectional composites is presented with the objective of stressing the need for using appropriate constitutive equations when modeling the behavior of the constituents. It is demonstrated that pseudo-constitutive relations, such as those obtained from constant stress creep experiments for example, can not be used to describe the mechanical behavior of the constituents when modeling the creep of composites. By describing the mechanical behavior of the composite constituents using linear viscoelastic models, an analysis is presented to assess the type of errors which are incurred when inappropriate constitutive relations are used. Other considerations for modeling the creep behavior of ceramic matrix composites are discussed.

22013 (CONF-940188–1) **Overview of ORNL/NRC programs addressing durability of concrete structures.** Naus, D.J.; Oland, C.B. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Workshop on concrete performance and D modeling for LLW disposal; Gaithersburg, MD (United States); 31 Jan - 2 feb 1994. Order Number DE94013631. Source: OSTI; NTIS; INIS; GPO Dep.

The role of reinforced concrete relative to its applications as either safety-related structures in nuclear power or engineered barriers of low-level radioactive waste disposal facilities is described. Factors that can affect the long-term durability of reinforced concrete are identified. Overviews are presented of the Structural Aging Program, which is addressing the aging management of safety-related concrete structures in nuclear power plants, and the Permeability Test Methods and Data Program, which is identifying pertinent data and information for use in performance assessments of engineered barriers for low-level radioactive waste disposal.

22014 (CONF-940411–17) **Ionic properties of hydrogenated and fluorinated fullerenes.** Compton, R. (Oak Ridge National Lab., TN (United States)); Hettich, R.; Jin, Changming; Tuinman, A.; Dunlap, B. Oak Ridge National Lab., TN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (United States); 4-8 Apr 1994. Order Number DE94012110. Source: OSTI; NTIS; GPO Dep.

Using mass spectrometry, the ionization potentials (IP) of $C_{60}H_n$ for even-numbered n=2-12 were determined to be 6.75-7.5 eV, and for odd-numbered n were below 6.75 eV (for C_{60}, IP is 7.65 eV). Electron affinities (EA) of these species rapidly decrease with increasing n. IPs and EAs for $C_{60}F_x$, on the other hand, both increase dramatically upon fluorination. A second electron can be added to gaseous $C_{60}F_{48}^-$; the resulting doubly charged anion is more stable than the singly charged anion.

22015 (CONF-940411–29) **Processing of thermoset prepreg laminate via exposure to microwave radiation.** Paulauskas, F.L. (Oak Ridge National Lab., TN (United States)); Meek, T.T. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (United States); 4-8 Apr 1994. Order Number DE94013268. Source: OSTI; NTIS; GPO Dep.

Studies of microwave-assisted curing of neat resins (epoxy) and unidirectional glass and carbon fiber laminates have shown that a substantial reduction in the curing time was obtained. This may be explained by the penetration of microwave energy directly and throughout the laminate with enhancement of the kinetics of the chemical reaction. Results of this work indicate that the microwave assisted curing of glass fiber laminates also shows a substantial reduction of the required curing time. Microwave radiation of 2.45 GHz has been demonstrated to be an acceptable method to cure unidirectional carbon fiber laminates. Also, effective curing of crossply (0/90) laminates through this method was observed when proper rotation of the parts accompanied the curing process. This is in accordance with previous work. Multidirectional carbon fiber/epoxy laminates demonstrate a lack of coupling during the curing process. A direct curing of these laminates was not possible by microwave radiation with the experimental approach used, in agreement with previous work. Nevertheless, a moderate reduction

in the curing time of these thin laminates was observed due to hybrid curing.

22016 (CONF-940412–5) **Methodologies for the thermomechanical characterization of continuous-fiber ceramic matrix composites: A review of test methods.** Lara-Curzio, E. (Oak Ridge National Lab., TN (United States)); Ferber, M.K.; Jenkins, M.G. Oak Ridge National Lab., TN (United States). [1994]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 39. international symposium of the Society for the Advancement of Material and Process Engineering and exhibition; Anaheim, CA (United States); 11-14 Apr 1994. Order Number DE94012111. Source: OSTI; NTIS; GPO Dep.

Requirements for thermomechanical characterization of ceramic matrix composite materials are reviewed. Feasibility of adapting existent room temperature test methods for polymer and metal matrix composites to test ceramic matrix composites at room and elevated temperatures is investigated.

22017 (CONF-940521–1) **Effect of extrusion parameters on consolidation of tungsten-hafnium and tungsten-steel powders.** Ohriner, E.K. (Oak Ridge National Lab., TN (United States)); Sikka, V.K.; Kapoor, D. Oak Ridge National Lab., TN (United States). [1994]. 24p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From International mining trade show and 96th annual meeting of the Canadian Institute of Mining, Metallurgy and Petroleum; Toronto (Canada); 1-4 May 1994. Order Number DE94013270. Source: OSTI; NTIS; GPO Dep.

Purpose of this study was to evaluate the fabrication of tungsten-steel and tungsten-hafnium composite materials by hot extrusion of canned powders. The W-28 wt % Hf composite was consolidated by extrusion of blended powders with preheat temperatures over the temperature range of 1100 to 1400 C. Materials were fully dense and exhibited substantial elongation of the tungsten phase within the hafnium matrix, which was further elongated by re-extrusion. The flow stress, as characterized by the extrusion constant, decreased with increasing temperature up to 1300 C and increased substantially at 1400 C as significant quantities of intermetallic phase were formed during preheating. A mixture of tungsten powder with 10 wt % steel powder was consolidated to full density by hot extrusion at a 1600 C preheat temperature and a reduction ratio of 4.2. Microstructures were found to be essentially fully recrystallized at 1300 C preheat and to be partially recrystallized at lower preheat temperatures.

22018 (CONF-940641–1) **Effects of substrate temperature on metal colloid formation and on optical response in metal ion implanted silica.** Magruder, R.H. III (Vanderbilt Univ., Nashville, TN (United States)); Weeks, R.A.; Anderson, T.S.; Osborne, D.H. Jr.; Zuhr, R.A.; White, C.W. Oak Ridge National Lab., TN (United States). Apr 1994. 9p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant DAAH04-93-G-0123. From 8. world ceramic congress; Florence (Italy); 29 Jun - 4 jul 1994. Order Number DE94013633. Source: OSTI; NTIS; GPO Dep.

The effects of substrate temperature during implantation of Au and Cu in high purity silica on particle sizes and optical properties are examined. The implantations result in the formation of nanometer dimension Au and Cu metal particles in the silica substrates. Increasing substrate temperature duding implantation results in increasing particle size in both systems. The linear absorption increases and the intensity dependent part of the refraction index n_2 increases with increasing particle size.

22019 (CONF-940753–7) **Microstructure and chemistry of MgO- and CoO-doped nickel-titanate spinels.** Anderson, I.M. (Oak Ridge National Lab., TN (United States)); Bentley, J.; Carter, C.B. Oak Ridge National Lab., TN (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant DMR-8901218. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012741. Source: OSTI; NTIS; GPO Dep.

Four specimens $Me_xNi_{1-x}O$ - 14.2 mol% TiO_2 (Me=Mg,Co and x=0.1 or 0.2) were prepared by cold pressing and firing. After heating and quenching, slices were examined in a TEM and x-ray spectrometry carried out. Dark-field images were recorded near the [001]-pole of the two cubic phases with spinel (220) reflection. The spinel-structured phase appears bright, the periclase-structured phase dark. In the 20% CoO doped specimen, the spinel and periclase phases form a continuously interpenetrating network (scale 40 nm); examination of the site distributions with ALCHEMI indicates that the Ti cations occupy mostly the octahedral site (tetrahedral site in undoped material). The spinel $MgNiTiO_4$ is unstable. The arrangements of the some of the faceted particles in groups suggest that a large periclase-structured particle may have subdivided.

22020 (CONF-940753–19) **In-situ TEM crystallization of sol-gel derived $BaTiO_3$ thin films.** Mecartney, M.L. (California Univ., Irvine, CA (United States). Dept. of Materials Science and Engineering); Gust, M.C.; Evans, N.D. Oak Ridge National Lab., TN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94013260. Source: OSTI; NTIS; GPO Dep.

Plan view and cross sectional view samples of pyrolyzed Ba-Ti methoxypropoxide films on (100)Si were prepared in the amorphous form. In-situ hot stage experiments were conducted in a Philips CM30 to follow the crystallization process. With time at 750 C, large grains nucleated mostly at the $BaTiO_3$ surface; the regions near the Si did not crystallize. 3 figs, 2 refs.

22021 (DOE/CE/23810–38) **Materials compatibility and lubricant research on CFC-refrigerant substitutes: Quarterly technical progress report, 1 January 1994–31 March 1994.** Szymurski, S.R.; Hawley, M.; Hourahan, G.C.; Godwin, D.S. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Apr 1994. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE94012352. Source: OSTI; NTIS; GPO Dep.

The Materials Compatibility and Lubricants Research (MCLR) program supports critical research to accelerate the introduction of CFC and HCFC refrigerant substitutes. The MCLR program addresses refrigerant and lubricant properties and materials compatibility. Primary elements of the work include data collection and dissemination, materials compatibility testing, and methods development. The work is guided by an Advisory Committee consisting of technical experts from the refrigeration and air-conditioning industry and government agencies. The Air-Conditioning and Refrigeration Technology Institute, Inc., (ARTI) manages and contracts multiple research projects and a data collection and dissemination effort. Detailed results from these projects are reported in technical reports prepared by each subcontractor.

22022 (DOE/OR–2001) **Continuous Fiber Ceramic Composite (CFCC) Program: Inventory of federally funded CFCC R&D projects.** Richlen, S. (USDOE Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC (United States). Office of Industrial Technologies); Caton, G.M.; Karnitz, M.A.; Cox, T.D.; Hong, W. Oak Ridge National Lab., TN (United States). May 1993. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–2930). Order Number DE94013602. Source: OSTI; NTIS; GPO Dep.

Continuous Fiber Ceramic Composites (CFCC) are a new class of materials that are lighter, stronger, more corrosion resistant, and capable of performing at elevated temperatures. This new type of material offers the potential to meet the demands of a variety of industrial, military, and aerospace applications. The Department of Energy Office of Industrial Technologies (OIT) has a new program on CFCCs for industrial applications and this program has requested an inventory of all federal projects on CFCCs that relate to their new program. The purpose of this project is to identify all other ongoing CFCC research to avoid redundancy in the OIT Program. The inventory will be used as a basis for coordinating with the other ongoing ceramic composite projects. The inventory is divided into two main parts. The first part is concerned with CFCC supporting technologies projects and is organized by the categories listed below. (1) Composite Design; (2) Materials Characterization; (3)

Test Methods; (4) Non-Destructive Evaluation; (5) Environmental Effects; (6) Mechanical Properties; (7) Database Life Prediction; (8) Fracture/Damage; and (9) Joining. The second part has information on component development, fabrication, and fiber-related projects.

22023 (DOE/PC/93225–2) **High performance materials in coal conversion utilization: Technical progress report, January 1, 1994–March 31, 1994.** Tennessee Univ., Tullahoma, TN (United States). Space Inst. Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93PC93225. Order Number DE94012612. Source: OSTI; NTIS; GPO Dep.

This is the second quarterly report concerning this three year grant on "High Performance Materials in Coal Conversion Utilization." The grant is for a joint university/industry effort under the US Department of Energy (DOE) University Coal Research Program. The University of Tennessee Space Institute (UTSI) is the prime contractor and The University of Pennsylvania and Lanxide Corporation are subcontractors. The administrative details involved in the finalizing of the subcontracts and the acquisition of the cost shared equipment by UTSI and the U of Pa has slowed progress somewhat, however, the project should go smoothly from this point on. Most of the efforts of this quarter have gone toward preparing the equipment and plans for the laboratory tests. Research into the identification of a suitable protective coating based on thermodynamic considerations and the development of techniques for their application as well as joining ceramic materials has been initiated.

22024 (ENEA-RT-INN–93-13) **Preparation and characterization of SiC-graphite composite materials.** Nannetti, C.A. (ENEA, Casaccia (Italy). Area Energia e Innovazione); D'Alessandro, G.; Filacchioni, G.; Guerrini, F.; Rescio, M.R. ENEA, Casaccia (Italy). Nov 1993. 12p. (RT/INN–93-13). Order Number DE94775227. Source: OSTI; NTIS (US Sales Only).

SiC-graphite composite materials with the secondary phase added as a powder were prepared by cold pressing and sintering or hot-pressing. The composite materials were characterized with particular reference to densification behaviour, thermal shock resistance and mechanical properties. The characteristics of the composite materials were compared to those of pure SiC 'reference' materials prepared in the same conditions.

22025 (INIS-mf–13808, pp. 111) **Anomalous low- and high-temperature behavior of ternary $RECu_1M$ compounds (RE=Y, Lu; M=Au, Pd, In).** Bauer, E. (Technische Univ., Vienna (Austria). Inst. fuer Experimentalphysik); Forsthuber, M.; Hauser, R.; Hilscher, G.; Holubar, T.; Resel, R.; Schaudy, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. INDIUM ALLOYS/electric conductivity; INDIUM ALLOYS/magnetization; INDIUM ALLOYS/specific heat; LUTETIUM ALLOYS/electric conductivity; LUTETIUM ALLOYS/magnetization; LUTETIUM ALLOYS/specific heat; YTTRIUM ALLOYS/electric conductivity; YTTRIUM ALLOYS/magnetization; YTTRIUM ALLOYS/specific heat; COPPER ALLOYS; GOLD ALLOYS; MAGNETIZATION; INTERMETALLIC COMPOUNDS; PALLADIUM ALLOYS; PRESSURE DEPENDENCE

22026 (INIS-mf–13808, pp. 112) **Magnetoresistance in YBaCuO in the superconducting fluctuations range.** Sekirnjak, C. (Vienna Univ. (Austria). Inst. fuer Festkoerperphysik); Lang, W.; Schwab, P.; Wang, X.Z.; Baeuerle, D. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/barium compounds; CUPRATES/yttrium compounds; SUPERCONDUCTIVITY/fluctuations; CUPRATES; MAGNETORESISTANCE; SUPERCONDUCTIVITY; FLUCTUATIONS; THIN FILMS

22027 (INIS-mf–13808, pp. 119) **Determination of the dielectric tensor of high-tc superconductors from LAPW band structure calculations.** Abt, R. (Inst. fuer Theoretische Physik, Univ. Graz, Graz (Austria)); Ambrosch-Draxl, C.; Knoll, P. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CUPRATES/barium compounds; CUPRATES/yttrium compounds; COMPARATIVE EVALUATIONS; CUPRATES; DIELECTRIC TENSOR; ELECTRONIC STRUCTURE

22028 (LA-UR–94-1520) **Computational modeling of fiber-reinforced composites.** Addessio, F.L.; Aidun, J.B. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940719–3: World congress on computational and applied mathematics, Atlanta, GA (United States), 11-15 Jul 1994). Order Number DE94012914. Source: OSTI; NTIS; GPO Dep.

A homogenization technique for simulating the dynamic response of metal-matrix composites has been implemented into EPIC, a three- dimensional, finite-element computer program. The technique includes a micromechanical model for the elastic-plastic response of the constituents. New additions to the constitutive description were a nonlinear mean stress-volumetric strain relation, a rate-form flow stress model, and four micromechanical failure modes. Preliminary simulations of Taylor impact tests gave satisfactory results; The composite anisotropy was well represented and the damage effects were qualitatively correct. The calculations was slowed by less than 20% using the micromechanical homogenization model explicitly. Computing speed should be recovered substantially for matrix yield models like viscoplasticity that permit direct calculation of the plastic strain. The metal plasticity model requires solving for the microvariables twice each time step. The present approach can be extended to epoxy or ceramic composites by inclusion of appropriate constitutive relations.

22029 (LA-UR–94-1715) **Quantum confinement in GaP nanoclusters.** Laurich, B.K.; Smith, D.C.; Healy, M.D. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940411–23: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013119. Source: OSTI; NTIS; GPO Dep.

We have prepared GaP and GaAs nanoclusters from organometallic condensation reactions of $E[Si(ChH_3)3]3$ (E = P, As) and $GaCl_3$. The size of the as synthesized clusters is 10 Å to 15 Å. Larger clusters of 20 Å to 30 Å size were obtained by thermal annealing of the as grown material. X-ray diffraction and transmission electron microscopy confirm the high crystalline quality. A lattice contraction of 6.7% could be seen for 10 Å sized GaAs clusters. The clusters are nearly spherical in shape. Optical absorption spectra show a distinct line which can be assigned to the fundamental transition of the quantum confined electronic state. The measured blue shift, with respect to the GaP bulk absorption edge is 0.53 eV. As the cluster is smaller than the exciton radius, we can calculate the cluster size from this blue shift and obtain 20.2 Å, consistent with the results from X-ray diffraction of 19.5 Å for the same sample.

22030 (LA-UR–94-1730) **Mechanical behavior of $MoSi_2$ and $MoSi_2$ composites.** Petrovic, J.J. Los Alamos National Lab., NM (United States). [1994]. 27p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940598–1: International conference on high-temperature intermetallics, San Diego, CA (United States), 16-19 May 1994). Order Number DE94013116. Source: OSTI; NTIS; GPO Dep.

$MoSi_2$ is a key member of the new class high temperature structural silicide materials. Important features of the mechanical behavior of $MoSi_2$ and $MoSi_2$ composites are reviewed. The mechanical properties of $MoSi_2$ single crystals, polycrystalline $MoSi_2$,

and $MoSi_2$-based composites are discussed in association with properties such as elevated temperature deformation and low temperature fracture toughness. Interrelationships between single crystal, polycrystal, and composite mechanical behavior are identified.

22031 (LBST–11/92, pp. 480.1-480.9) **Task A: safety of materials and components of the EQHHPP.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

Tanks for the transportation and storage of large amounts of liquid hydrogen (LH2) as well as highly stressed components in contact with gaseous hydrogen will be the subject of safety analyses to determine the safety margin against catastrophic failure. The work done for the Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP) Supplementary Task Contract No. 480 Part 'Materials' supplements these materials data especially with respect to weldments and outlines special problems with respect to the materials and the design of the relevant systems. Carrying out the task it became clear that a meaningful treatment of the safety problem needs information from the system manufacturers and operators beyond those provided in the available literature. (orig./HW)

22032 (NREL/TP–451-6395) **Small-angle x-ray scattering studies of microvoids in amorphous-silicon-based semiconductors: Annual subcontract report, February 1, 1992–January 31, 1993.** Williamson, D.L. (Colorado School of Mines, Golden, CO (United States)); Jones, S.J.; Chen, Y. National Renewable Energy Lab., Golden, CO (United States). May 1994. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006931. Source: OSTI; NTIS; GPO Dep.

Our general objectives are to provide new details of the microstructure for the size scale from about 1 to 30 nm in high-quality a-Si:H and related alloys prepared by current state-of-the-art deposition methods as well as by new and emerging deposition technologies and thereby help determine the role of microvoids and other density fluctuations in controlling the opto-electronic properties. More specifically, the objectives are to determine whether the presence of microstructure as detected by small-angle x-ray scattering (SAXS) (1) limits the photovoltaic properties of device-quality a-Si:H, (2) plays a role in determining the photo-stability of a-Si:H, and (3) is responsible for degradation of the photovoltaic properties due to alloying with Ge, C and other constituents. The approach involves collaboration with several groups that can supply relevant systematic sets of samples and the associated opto-electronic data to help address these issues. Since the SAXS technique has not been a standard characterization technique for thin-film materials, and was recently set up at CSM with support by NREL, the project involves considerable development of the method with regard to standardizing the procedures, minimizing substrate influences and implementing improved data reduction and modeling methodology. Precise, highly reproducible, and accurate results are being sought in order to allow useful, reliable, and sensitive comparisons of materials deposited under different conditions, by different methods, and by different systems that represent the same nominal method.

22033 (ORNL/Sub–85-55901/04) **Modeling of forced CVI for tube fabrication.** Starr, T.L. (Georgia Tech Research Inst., Atlanta, GA (United States)); Smith, A.W. Oak Ridge National Lab., TN (United States); Georgia Tech Research Inst., Atlanta, GA (United States). May 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012718. Source: OSTI; NTIS; GPO Dep.

The forced flow/thermal gradient chemical vapor infiltration process (FCVI) can be used for fabrication of tube-shaped components of ceramic matrix composites. Recent experimental work at Oak Ridge National Laboratory (ORNL) includes process and materials development studies using a small tube reactor for tubes 20 cm long and 2.5 cm ID. Adaption of FCVI for this geometry involves significant changes in fixturing as compared to disk-shaped preforms previously fabricated. The authors have used this computer model of the CVI process to simulate tube densification and to identify process modifications that will decrease processing time.

22034 (PNL-SA–24049) **A review of fundamental coating issues for high temperature composites.** Courtright, E.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940440–3: International conference on metallurgical coatings and thin films, San Diego, CA (United States), 25-29 Apr 1994). Order Number DE94013328. Source: OSTI; NTIS; GPO Dep.

This review addresses many of the fundamental issues associated with the use of coatings in high temperature, aggressive, environments with specific emphasis on multi-component composites. A major concern is damage caused by oxygen permeation into matrix cracks causing internal oxidation and attacking along fiber/matrix interfaces. Many prospective coatings that might be used to protect composites are susceptible to hot corrosion, particularly by small vanadate concentrations which can degrade the coating and, thereby, enhance the permeation of other aggressive species. The mechanical stability of coating systems is also a major consideration in determining performance. Large differences in thermal expansion coefficients between coating and the composite substrate are not necessarily ameliorated by the practice of grading interfaces. However, the use of functionally graded coatings can be beneficial in reducing interlaminar shear and across-ply strains. Crack management, including the use of sealants, can be an essential part of a functional design, but the thermochemical stability of the glass sealant must be considered at elevated temperatures.

22035 (SAND–93-3822C) **A dynamic model of a linear actuator based on polymer hydrogel.** Brock, D. (Massachusetts Inst. of Tech., Cambridge, MA (United States)); Lee, Woojin; Segalman, D.; Witkowski, W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940691–2: 2. international conference on intelligent materials, Williamsburg, VA (United States), 5-8 Jun 1994). Order Number DE94010800. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The design and analysis of a series of linear actuators based on polymer hydrogel is presented. The actuators use arrays of pH sensitive gel fibers together with a fluid irrigation system to locally and rapidly regulate the composition of the solution. A dynamic model is constructed for one of the linear actuators, which includes the polymer gel, fluidic system, and transmission mechanics. Emphasis in the design and mechanical modeling of the actuators is placed on the complete system including not only the polymer gel, but also on the containment system, irrigation scheme, and servo valving system.

22036 (SAND–93-3824C) **Mechanisms for the operation of thin film transistors on ferroelectrics.** Seager, C.H. (Sandia National Labs., Albuquerque, NM (United States)); McIntyre, D.; Tuttle, B.A.; Evans, J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9403120–3: 6. international symposium on integrated ferroelectrics, Monterey, CA (United States), 14-16 Mar 1994). Order Number DE94013446. Source: OSTI; NTIS; GPO Dep.

The electric field emanating from the surface of a poled ferroelectric can control the conduction properties of an overlaying semiconducting film, this combination of materials can thus serve as a non-destructive readout, non-volatile memory device. Here the authors will describe a variety of experimental studies of these devices designed to probe the physics of their operation. The experimental systems included sputtered, n-type semiconductor (SC) films of In_2O_3 and ZnO deposited on bulk PLZT ferroelectrics (FE) and thin PZT FE films. Two distinctly different types of device response were measured in this study; in the first, the change in SC film conductance observed in the remanent FE state is in the direction expected from the remanent polarization vector in the ferroelectric. In the second, typically seen in the thin film FE devices, the opposite behavior is observed. They find that these two general cases of behavior, including the observed variations of the SC

film conductances and carrier mobilities, can be described by a general model which takes into account not only the FE displacement vector, but also charge injected from the semiconductor into the ferroelectric during biasing of the gate.

22037 (SAND–94-0063C) **Pressure studies of alkali, alkaline earth and rare earth doped C_{60} superconductors.** Schirber, J.E. (Sandia National Labs., Albuquerque, NM (United States)); Bayless, W.R.; Kortan, A.R.; Ozdas, E.; Zhou, O.; Murphy, D.; Fischer, J.E. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940529–14: 185. Electrochemical Society meeting, San Francisco, CA (United States), 22-27 May 1994). Order Number DE94013345. Source: OSTI; NTIS; GPO Dep.

Pressure studies of the superconducting transition temperature T_c of the alkali metal doped C_{60} compounds helped to establish a universal curve of T_c versus lattice constant upon which nearly all of these materials lie. Various theoretical schemes incorporate this finding and suggest that only the lattice parameter and not the details of the dopant determine T_c. Ca_5C_{60}, the highest T_c member of the alkaline earth doped C_{60} superconductor has a T_c which lies on this universal curve so this material, from these considerations, should have the same large negative pressure derivative as the alkali doped superconductors. We have measured dT_c/dP for Ca_5C_{60} and for Yb_xC_{60} (x near 3) and find small and positive values indicating that the theoretical models must be expanded to include band structure effects.

22038 (SAND–94-1019C) **Residual stress and Raman spectra of laser deposited highly-tetrahedral-coordinated-amorphous-carbon films.** Friedmann, T.A.; Siegal, M.P.; Tallant, D.R.; Simpson, R.L.; Dominguez, F. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940411–18: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94012067. Source: OSTI; NTIS; GPO Dep.

We are studying carbon thin films by using a pulsed excimer laser to ablate pyrolytic graphite targets to form highly tetrahedral coordinated amorphous carbon (αt-C) films. These films have been grown on room temperature p-type Si (100) substrates without the intentional incorporation of hydrogen. In order to understand and optimize the growth of αt-C films, parametric studies of the growth parameters have been performed. We have also introduced various background gases (H_2, N_2 and Ar) and varied the background gas pressure during deposition. The residual compressive stress levels in the films have been measured and correlated to changes in the Raman spectra of the αt-C band near 1565 cm^{-1}. The residual compressive stress falls with gas pressure, indicating a decreasing atomic sp^3-bonded carbon fraction. We find that reactive gases such as hydrogen and nitrogen significantly alter the Raman spectra at higher pressures. These effects are due to a combination of chemical incorporation of nitrogen and hydrogen into the film as well as collisional cooling of the ablation plume. In contrast, films grown in non-reactive Ar background gases show much less dramatic changes in the Raman spectra at similar pressures.

22039 (SAND–94-1104C) **Explanation of enhanced mechanical degradation rate for radiation- aged polyolefins as the aging temperature is decreased.** Gillen, K.T.; Clough, R.L.; Wise, J.; Malone, M.G. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940813–3: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94011026. Source: OSTI; NTIS; INIS; GPO Dep.

Degradation rates are normally increased by increasing the responsible environmental stresses. We describe results for a semi-crystalline, crosslinked polyolefin material that contradicts this assumption. In particular, under combined radiation plus thermal environments, this material mechanically degrades much faster at room temperature than it does at elevated temperatures. The probable explanation for this phenomenon relates to the importance on mechanical properties of the tie molecules connecting crystalline and amorphous regions. Partial melting and reforming/reorganization of crystallites occurs throughout the crystalline melting region (at least room temperature up to 126 C), with the rate of such processes increasing with an increase in temperature. At low temperatures, this process is sufficiently slow such that a large percentage of the radiation-damaged tie molecules will still connect the amorphous and crystalline regions at the end of aging, leading to rapid reductions in tensile properties. At higher temperatures, the enhanced annealing rate will lead, during the aging, to the establishment of new, undamaged tie molecules connecting crystalline and amorphous regions. This healing process will reduce the degradation rate. Evidence in support of this model is presented.

22040 (SAND–94-1262C) **Infrared sensor for CVD deposition of dielectric films.** Niemczyk, T.M. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemistry); Franke, J.E.; Zhang, S.; Haaland, D.M. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940411–21: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94012915. Source: OSTI; NTIS; GPO Dep.

Infrared emission (IRE) spectra were obtained from two borophosphosilicate glass (BPSG) thin-film sample sets. The first set consisted of 21 films deposited on undoped silicon wafers, and the second set consisted of 9 films deposited on patterned and doped (product) wafers. The IRE data were empirically modeled using partial least-squares calibration to simultaneously quantify four BPSG thin-film properties. The standard errors of the determinations when modeling the 21 monitor wafers were <O.I wt % for boron and phosphorus content, 36 Å for film thickness, and 1.9°C for temperature. The standard errors of the determinations based on the product wafers were 0.13 wt % each for B and P content, 120 Å for film thickness, and 5.9 C for temperature.

22041 (SAND–94-8641C) **First-principles determination of the polarizabilities of carbon tubules as a function of length.** Quong, A.A. (Sandia National Labs., Livermore, CA (United States)); Pederson, M.R. Sandia National Labs., Livermore, CA (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-940411–20: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013015. Source: OSTI; NTIS; INIS; GPO Dep.

We use the local-density-approximation to the density-functional theory to determine the axial polarizabilities of fullerene tubules as a function of length and winding topologies. Specifically, we present linear polarizabilities for tubules of composition $C_{12}H_{24}$, $C_{36}H_{24}$, $C_{40}H_{20}$ and $C_{60}H_{24}$. The size-dependent variation in the dipole-coupled gaps between pairs of occupied and unoccupied levels leads to enhancements in the polarizability per valence electron as the length of the tubule increases. The results are compared to recent density-functional based calculations of the linear and nonlinear polarizabilities for fullerene and benzene molecules.

22042 (SP–94-06) **Repeated processing with intermediate accelerated ageing of a stabilized LDPE.** Lund, V. (Chalmers Univ. of Technology, Gothenburg (Sweden). Dept. of Polymer Technology). Swedish National Testing and Research Inst., Boraas (Sweden). 1994. 38p. (In Swedish). Order Number DE94771024. Source: OSTI; NTIS.

Examination paper.

The purpose of this work was to investigate how repeated processing with intermediate accelerated ageing influences a slightly stabilized low density polyethylene, and how large contributions to the degradation come from ageing and processing respectively. Three different test series were made: one series which was processed repeatedly, one series which was exposed to accelerated ageing only, and one which was exposed to both processing and accelerated ageing alternately. The series included ten processings and/or nine ageings. The polymer was processed by means of extrusion. The accelerated ageing implied exposure in a forces-air oven for 72 hours at 90 ±2 degrees C in air, which should be equivalent to at least one year of use at 25 degrees C. Samples were taken after each extrusion and ageing respectively. They were analysed by: tensile test, fourier transform infrared

spectroscopy, size exclusion chromatography, melt, flow rate, differential scanning calorimetry, and scanning electron microscopy. The results indicate that the material was not degraded to a significant degree by the treatments performed due to a higher degree of stabilization than there had been reason to assume. The results obtained cannot be assumed to be valid for other materials, processing methods, ageing temperatures or ageing times.

22043 (UCRL-CR–116392) **The problems of the minimal surface and minimal lineal measure in three dimensions.** Christensen, R.M. Lawrence Livermore National Lab., CA (United States). Feb 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94013002. Source: OSTI; NTIS; GPO Dep.

A solution is given to the classical problem of the minimal surface in three dimensions formed from a repeating cell microstructure under isotropic conditions. The solution is found through a global/local minimization procedure and the resulting basic cell is composed of 14 faces. At the junctions where the intersections between faces meet at a point, half of the junctions involve 4 intersections and half involve 3 intersections. The same general solution also applies tot he related minimal lineal measure problem where the measure is that of the length of the intersections connecting the junctions. Some implications and applications for materials science are given.

22044 (UCRL-JC–114014-Rev.1) **Precision machining and polishing of scintillating crystals for large calorimeters and hodoscopes: Revision 1.** Wuest, C.R. (Lawrence Livermore National Lab., CA (United States)); Fuchs, B.A.; Holdener, F.R.; Heck, J.L. Jr. Lawrence Livermore National Lab., CA (United States). Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940411–19-Rev.1: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94012060. Source: OSTI; NTIS; INIS; GPO Dep.

New machining and polishing techniques have been developed for large scintillating crystal arrays such as the Barium Fluoride Electromagnetic Calorimeter for the GEM Detector at SSCL, the Crystal Clear Collaboration's cerium fluoride or lead tungstenate calorimeter at the proposed LHC and CERN, the PHENIX Detector at RHIC (barium fluoride), and the cesium iodide Calorimeter for the BaBar Detector at PEP-2 B Factory at SLAC. The machining and polishing methods to be presented in this paper provide crystalline surfaces without sub-surface damage or deformation as verified by Rutherford Back-scattering (RBS) analysis. Surface roughness of about 10–20 angstroms and sub-micron mechanical tolerances have been demonstrated on large barium fluoride crystal samples. Mass production techniques have also been developed for machining the proper angled surfaces and polishing up to five 50 cm long crystals at one time. These techniques utilize kinematic mount technology developed at LLNL to allow precision machining and polishing of complex surfaces. They will present this technology along with detailed surface studies of barium fluoride and cerium fluoride crystals polished with this technique.

22045 (UCRL-JC–115222) **An amorphous fluoropolymer: Next generation optical coating candidate.** Chow, R.; Loomis, G.E.; Spragge, M.K.; Lindsey, E.L.; Rainer, F.; Ward, R.L.; Kozlowski, M.R. Lawrence Livermore National Lab., CA (United States). May 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9406168–1: International symposium on optical interference coatings, Grenoble (France), 6-14 Jun 1994). Order Number DE94012386. Source: OSTI; NTIS; GPO Dep.

Anti-reflective (AR) and high reflector (HR) optical coatings were made by physical vapor deposition (PVD) of Teflon AF2400, a perfluorinated amorphous polymer. The AR had the highest laser damage thresholds recorded for PVD coatings at the Lawrence Livermore National Laboratory damage facility. The HR was a multilayer of ZnS and AF2400. The bandwidth was 550 mn, centered at 1064 mn. Single layers of Teflon AF2400 deposited by PVD were characterized optically. The refractive index could be intentionally reduced below the bulk value by varying either deposition rate or substrate temperature. Scanning electron microscopy and nuclear magnetic resonance observations indicated that morphological changes caused the variations in the refractive index rather than compositional changes.

22046 (UCRL-LR–117167) **Accelerated hygrothermal stabilization of composite materials.** Gale, J.A. Lawrence Livermore National Lab., CA (United States). May 1994. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012376. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to University of California, Davis.

Experimentation validated a simple moisture conditioning scheme to prepare Gr/Ep composite parts for precision applications by measuring dimensional changes over 90 days. It was shown that an elevated temperature moisture conditioning scheme produced a dimensionally stable part from which precision structures could be built/machined without significant moisture induced dimensional changes after fabrication. Conversely, that unconditioned Gr/Ep composite panels exhibited unacceptably large dimensional changes (i.e., greater than 125 ppM). It was also shown that time required to produce stable parts was shorter, by more than an order of magnitude, employing the conditioning scheme than using no conditioning scheme (46 days versus 1000+ days). Two final use environments were chosen for the experiments: 50% RH/21C and 0% RH/21C. Fiberite 3034K was chosen for its widespread use in aerospace applications. Two typical lay-ups were chosen, one with low sensitivity to hygrothermal distortions and the other high sensitivity: [0, ± 45, 90]s, [0, ± 15, 0]s. By employing an elevated temperature, constant humidity conditioning scheme, test panels achieved an equilibrium moisture content in less time, by more than an order of magnitude, than panels exposed to the same humidity environment and ambient temperature. Dimensional changes, over 90 days, were up to 4 times lower in the conditioned panels compared to unconditioned panels. Analysis of weight change versus time of test coupons concluded that the out-of-autoclave moisture content of Fiberite 3034K varied between 0.06 and 0.1%.

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22047 (ANL–94/15) **Chemical Technology Division annual technical report, 1993.** Battles, J.E.; Myles, K.M.; Laidler, J.J.; Green, D.W. Argonne National Lab., IL (United States). Apr 1994. 198p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013050. Source: OSTI; NTIS; INIS; GPO Dep.

Chemical Technology (CMT) Division this period, conducted research and development in the following areas: advanced batteries and fuel cells; fluidized-bed combustion and coal-fired magnetohydrodynamics; treatment of hazardous waste and mixed hazardous/radioactive waste; reaction of nuclear waste glass and spent fuel under conditions expected for an unsaturated repository; separating and recovering transuranic elements, concentrating radioactive waste streams with advanced evaporators, and producing ^{99}Mo from low-enriched uranium; recovering actinide from IFR core and blanket fuel in removing fission products from recycled fuel, and disposing removal of actinides in spent fuel from commercial water-cooled nuclear reactors; and physical chemistry of selected materials in environments simulating those of fission and fusion energy systems. The Division also conducts basic research in catalytic chemistry associated with molecular energy resources and novel ceramic precursors; materials chemistry of superconducting oxides, electrified metal/solution interfaces, molecular sieve structures, thin-film diamond surfaces, effluents from wood combustion, and molten silicates; and the geochemical processes involved in water-rock interactions. The Analytical Chemistry Laboratory in CMT also provides a broad range of analytical chemistry support.

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Refer also to citation(s) 20608, 20687, 20822, 20824, 20929, 20930, 20943, 20946, 20952, 20956, 21013, 21027, 21037, 21053, 21062, 21088, 21104, 21850, 21928, 21941, 22046, 22112, 22134, 22184, 22429, 22456, 22468, 22551, 22611, 23291

22048 (ANL/MSD/CP–82370) **A brightness comparison of thermionic electron sources in a TEM.** Cook, R.E. Argonne National Lab., IL (United States). Mar 1994. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940753–14: Microscopy Society of America and Microbeam Analysis Society joint meeting, New Orleans, LA (United States), 31 Jul - 5 aug 1994). Order Number DE94013300. Source: OSTI; NTIS; GPO Dep.

In the quest for thermionic electron sources brighter than the standard tungsten filament, manufacturers have given us first LaB_6 and then CeB_6 single crystals. This paper compares these 3 electron sources under typical operating conditions in a Philips EM420T transmission microscope.

22049 (CNIC–00764) **The determination of iron-59 in water.** Zhao Min (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Ban Ying. China Nuclear Information Centre, Beijing, BJ (China). Jun 1993. 10p. (In Chinese). (IAE–0120.). Order Number DE94625129. Source: OSTI; NTIS (US Sales Only); INIS.

A method to analyse iron-59 in water is introduced. The procedure of this method includes concentration by co-precipitation with hydroxides purification by anion exchange, electrodeposition in $NH_4H_2PO_4$-$(NH_4)_2CO_3$ system and final measurements of beta activity with a background beta-counter. The effect of iron carrier amount and pH value of water sample on the carrying Fe-59, and the effect of concentration hydrochloric acid, flowrate of adsorption and elutriation with 6 mol/L HCl-1% H_2O_2 solution on the adsorption efficiency have been studied. The experimental results indicate that for 101 water sample, both the chemical and radiochemical yields are greater than 90%. For ^{51}Cr, ^{60}Co, ^{65}Zn, ^{95}Zr-^{95}Nb and ^{137}Cs the decontamination factor is greater than 10^3. The minimum detectable limit of this method is 3.8×10^{-3} Bq/L.

22050 (CONF-9311177–1) **A proposal for the analysis of nitrocellulose in soil or compost.** Griest, W.H. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Agreement 1016-B123-A1. From United States Army/Construction Engineering Research Laboratory (USA/CERL) workshop on nitrocellulose research; West Lafayette, IN (United States); 4-5 Nov 1993. Order Number DE94007223. Source: OSTI; NTIS; GPO Dep.

Currently, there is no "standard" analytical method for the measurement of nitrocellulose (NC) in soil or compost. At the present, an indirect method is used. This method extracts the NC from soil or compost, separates out nitrate or nitrite ions, hydrolyzes the NC nitrogroups, and measures the liberated nitrite colorimetrically. Major weaknesses are that the %N content or degree of nitrate substitution (DS) of the NC must be known to convert the nitrate measurements to NC concentrations, incomplete separation of nitrate/nitrite ions coextracted from the soil leads to over-estimation of NC, and incomplete extraction and/or hydrolysis of the NC cause a low bias to the NC estimations. Additionally, the method provides no information about the condition of the NC. Characterization of the molecular weight distribution and detection of functional groups in addition to nitrate ester would be highly useful in developing and applying remediation technologies. This paper proposes a size exclusion chromatography (SEC)-based method for analysis of NC in soil, compost, or other sample matrices. The method has the potential to provide both quantitative and qualitative information. The proposed method is described and some of the factors which must be addressed in method development and validation are discussed. SEC has much potential as a tool for guiding the development and application of remediation technologies for NC contaminated soils and other matrices. The extraction of NC from soil without deterioration is probably the main technical difficulty to overcome. Development of an analytical method is encouraged.

22051 (CONF-940753–6) **Measurement of scanning electron microscope resolution.** Bentley, J. (Oak Ridge National Lab., TN (United States)); Kenik, E.A.; Evans, N.D. Oak Ridge National Lab., TN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94012661. Source: OSTI; NTIS; GPO Dep.

Resolution is traditionally determined with specimens such as gold islands on bulk C supports; however this is subjective. By substituting a thin C support for the traditional bulk C, while retaining the gold islands, the essential features of the traditional SEM resolution test specimen remain unchanged, but an independent and reliable measurement of particle sizes and spacings becomes possible using TEM. A test specimen consisting of latex spheres supported on a thin, holey C film, obliquely shadowed with gold, can be used for resolution tests at the sub-2nm level; the latex sphere arrangement, shadows in the gold coverage, and holes in the C film enable the same area to be found rapidly in TEM and SEM instruments. The area used for assessing SEM performance is also imaged by TEM, either before or after the SEM work; advantages of each sequence are discussed.

22052 (CONF-940753–15) **Specimen preparation of irradiated materials for examination in the atom probe field ion microscope.** Russell, K.F.; Miller, M.K. Oak Ridge National Lab., TN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994. Order Number DE94013255. Source: OSTI; NTIS; INIS; GPO Dep.

The atom probe field ion microscope (APFIM) requires specimens in the form of ultrasharp needles. Basic protective measures used to reduce exposure druing specimen preparation are discussed. The low-level radioactive specimen blanks may be made using a two-stage electropolishing process using a thin layer of electrolyte floating on a denser inert liquid; this produces a necked region and eventually two specimens from each single blank. The amount of material handled may also be reduced using a micropolishing technique to repolish blunt or fractured specimens. Control of contamination and possible spills is discussed.

22053 (CONF-940766–6) **[ALCHEMI formulated for delocalization and anti-site defects].** Anderson, I.M.; Bentley, J. Oak Ridge National Lab., TN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States);Oak Ridge Inst. for Science and Education, TN (United States). DOE Contract AC05-84OR21400. From 13. international congress on electron microscopy; Paris (France); 17-22 Jul 1994. Order Number DE94012740. Source: OSTI; NTIS; GPO Dep.

ALCHEMI (atom location by channeling enhanced microanalysis) provides a useful method for determining the site distributions of impurity atoms in crystals with multiple sublattices. Delocalization of low energy excitations and the dubious statistical confidence level of the technique are problems; a recent formulation of ALCHEMI analysis (Walls, 1992) addresses both problems. This paper extends this analysis for the distribution of atoms over two sublattices; expressions are derived for the fit parameters that are exact given the assumptions of the model, which allows for arbitrary localization constants, and for the possibility of anti-site defects.

22054 (DOE/EM–0157P) **Quality assurance guidance for laboratory assessment plates in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Analytical Services Div. May 1994. 84p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013040. Source: OSTI; NTIS; INIS; GPO Dep.

This document is one of several guidance documents developed to support the EM (DOE Environmental Restoration and Waste Management) Analytical Services program. Its purpose is to introduce assessment plates that can be used to conduct performance assessments of an organization's or project's ability to meet quality goals for analytical laboratory activities. These assessment plates are provided as non-prescriptive guidance to EM-support organizations responsible for collection of environmental data for remediation and waste management programs at DOE facilities. The assessments evaluate objectively all components of the analytical laboratory process to determine their proper selection and use.

22055 (DOE/EM–0159P) **Analytical laboratory quality assurance guidance in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Analytical

Services Div. May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013042. Source: OSTI; NTIS; INIS; GPO Dep.

This document introduces QA guidance pertaining to design and implementation of laboratory procedures and processes for collecting DOE Environmental Restoration and Waste Management (EM) ESAA (environmental sampling and analysis activities) data. It addresses several goals: identifying key laboratory issues and program elements to EM HQ and field office managers; providing non-prescriptive guidance; and introducing environmental data collection program elements for EM-263 assessment documents and programs. The guidance describes the implementation of laboratory QA elements within a functional QA program (development of the QA program and data quality objectives are not covered here).

22056 (DOE/EM–0160P) **The integrated performance evaluation program quality assurance guidance in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Analytical Services Div. May 1994. 29p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013043. Source: OSTI; NTIS; INIS; GPO Dep.

EM's (DOE's Environmental Restoration and Waste Management) Integrated Performance Evaluation Program (IPEP) has the purpose of integrating information from existing PE programs with expanded QA activities to develop information about the quality of radiological, mixed waste, and hazardous environmental sample analyses provided by all laboratories supporting EM programs. The guidance addresses the goals of identifying specific PE sample programs and contacts, identifying specific requirements for participation in DOE's internal and external (regulatory) programs, identifying key issues relating to application and interpretation of PE materials for EM headquarters and field office managers, and providing technical guidance covering PE materials for site-specific activities. (PE) Performance Evaluation materials or samples are necessary for the quality assurance/control programs covering environmental data collection.

22057 (DOE/EM–0161P) **Management Assessment Quality Assurance Guidance in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Analytical Services Div. May 1994. 15p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013376. Source: OSTI; NTIS; GPO Dep.

This document is one of several guidance documents developed by DOE EM pertaining to environmental restoration and waste management sampling and analysis activities. This guidance contains performance objectives and representative assessment criteria that can be used to conduct management assessments.

22058 (DOE/ER/13235–6) **Photochemical generation of the optoacoustic effect: Progress report.** Diebold, G.J. Brown Univ., Providence, RI (United States). Dept. of Chemistry. Oct 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13235. Order Number DE94013490. Source: OSTI; NTIS; GPO Dep.

Research during the last granting period has been conducted in four areas concerned with the photoacoustic effect: proof of six theorems concerning the time profiles of photoacoustic waves, generation of photoacoustic waves from a layered source, production of acoustic waves by laser irradiation of optically thin cylinders and layers, and generation of the photoacoustic effect by excitation of a transient optical grating in viscous fluids.

22059 (DOE/ER/13915–T4) **Development of immobilized ligands for actinide separations: Final report, June 1991–May 1994.** Paine, R.T. New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemistry. [1994]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG04-88ER13915. Order Number DE94012714. Source: OSTI; NTIS; INIS; GPO Dep.

Primary goals during this grant period were to (1) synthesize new bifunctional chelating ligands, (2) characterize the structural features of the Ln and An coordination complexes formed by these ligands, (3) use structural data to iteratively design new classes of multifunctional ligands, and (4) explore additional routes for attachment of key ligands to solid supports that could be useful for chromatographic separations. Some highlights of recently published work as well as a summary of submitted, unpublished and/or still in progress research are outlined.

22060 (DOE/MT/92015–1) **Ceramic membranes for gas separation at high temperatures: Final report.** Wang, C.J. Tuskegee Univ., AL (United States). Dept. of Chemical Engineering. Mar 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92MT92015. Order Number DE94013946. Source: OSTI; NTIS; GPO Dep.

Superior heat, wear, erosion, and corrosion resistance of ceramic materials have motivated the studies of processing-structure-performance interrelationships of ceramic membranes for high temperature gas separations. A literature review on pore transport mechanisms, physical structure of membranes, and module configuration of industrial membrane processes has been made to obtain a better understanding of membrane performance in gas separations. The research experience in decomposing polymer resins for ablative composites has stimulated a research interest in developing a dynamic model for membrane processes, incorporating a temperature effects on material and fluid properties. Brief summaries of the reviewed literature, permeability experiments, and process modeling are presented in this report.

22061 (DOE/PC/92118–T6) **Bench-scale demonstration of biological production of ethanol from coal synthesis gas: Quarterly report, January 1, 1994–March 31, 1994.** Engineering Resources, Inc., Fayetteville, AR (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92118. Order Number DE94013475. Source: OSTI; NTIS; GPO Dep.

This report presents results from the solvent selection, fermentation, and product recovery studies performed thus far in the development of a bench scale unit for the production of ethanol from coal-derived synthesis gas. Several additional solvents have been compared for their ability to extract ethanol from aqueous solutions of ethanol in water and fermentation permeate. The solvent 2,6-dimethyl-4-heptanol still appears to be the solvent of choice. Liquid-liquid equilibrium data have been collected for ethanol and 2,6-dimethyl-4-heptanol.

22062 (DOE/PC/92521–T129) **Production of carbon molecular sieves from Illinois coal: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Lizzio, A.A. (Illinois State Geological Survey, Champaign, IL (United States)); Rostam-Abadi, M.; Vyas, S.N. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012556. Source: OSTI; NTIS; GPO Dep.

Carbon molecular sieves (CMS) have become an increasingly important class of adsorbents for use in gas separation and recovery processes. The overall objective of this project is to determine whether Illinois coal is a suitable feedstock for the production of CMS and to evaluate the potential application of the products in commercial gas separation processes. In Phase I of this project, gram quantities of char were produced from IBC-102 coal in a fixed-bed reactor under a wide range of pyrolysis and activation conditions. The kinetics of adsorption of various gases, i.e., O_2, N_2, CO_2, CH_4 and H_2, on these chars at 25°C was studied. Several chars showed good potential for efficient O_2/N_2, CO_2/CH_4, CO_2H_2 and CH_4/H_2 separation; both high adsorption capacities and selectivities were achieved. The full potential of these materials in commercial gas separations has yet to be realized. In Phase II, the optimal char preparation conditions determined in Phase I are applied to production of larger quantities of CMS in a batch fluidized-bed reactor (FBR) and a continuous rotary tube kiln (RTFK).

22063 (ENEA-RT-INN–93-07) **Ammonia adsorption in cells for molecular spectroscopy.** Baldacchini, G. (ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta); Bellatreccia, A.; D'Amato, F. ENEA, Frascati (Italy). Centro Ricerche Energia - Area Energia e Innovazione. Apr 1993. 13p. (In Italian). (RT/INN–93-07). Order Number DE94775299. Source: OSTI; NTIS (US Sales Only).

This paper reports on the adsorption properties of different surfaces in cells for molecular spectroscopy at temperatures in the range -100: - +50 degrees C. Preliminary measurements show that teflon adsorbs less than gold at room temperature, while the opposite happens at low temperatures.

22064 (FZR–32, pp. 130-134) **A comparison of analytical methods for detection of ^{14}Ctrichloro acetic acid-derived radioactivity in needles and branches of spruce (Picea sp.).** Kretzschmar, M. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Bubner, M.; Matucha, M.; Uhlirova, H. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The branches (wood and needles) of spruces of varying age treated with ^{14}Ctrichloro acetic acid (3.7 GBq/mmol) were studied, using the following methods: Qualitative: - Conventional macroautoradiography with X-ray film and histological classification. Quantitative: - ^{14}C combustion analysis with the sample oxidizer A 307 (Canberra/Packard) followed by measurement of radioactivity using the LS counter 6000 (Beckman Instrumentts); - digital autoradiography with the Digital Autoradiograph LB 286 (Berthold GmbH); - digital autoradiography with the Bio-imaging Analyzer BAS 2000 (Fuji Film Co.). (orig.)

22065 (FZR–32, pp. 135-141) **Attempts at quantification of ^{3}H and ^{14}C distributions in tissue sections using various methods.** Kretzschmar, M. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Mixtacki, H.; Hahn, R. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The position and intensity of 2-dimensional radioactivity distributions are quantitatively measured by a device. The traditional X-ray or ^{3}H film has been replaced by a multiwire proportional counter or the phosphor imaging plate. (orig.)

22066 (GKSS–93/E/79) **Measuring system for local and real-time measurement of methane dissolved in seawater.** Wernecke, G. GKSS-Forschungszentrum Geesthacht GmbH (Germany). Inst. fuer Physik; Hannover Univ. (Germany). Fakultaet fuer Maschinenwesen. 1993. 227p. (In German). Order Number DE94773629. Source: OSTI; NTIS (US Sales Only).

This paper describes an underwater system for the measurement of dissolved methane. The range of concentrations is 50 ppt to 100 ppm, maximum water depth is 300 m, and data are provided by the shipboard computer continuously in real time. The measurement occurs by gas-phase infrared HeNe-laser absorptiometry. For the desorption of the gas from the water several techniques were investigated. Best operational performance was obtained from a microporous polypropylene hollow-fiber membrane module. Measured instationary concentration profiles agree well with modelled data. Field experiments with the system attached to a remotely operated underwater vehicle include natural background measurements and methane profile determinations around offshore drilling structures and natural sources of methane on the sea floor of the North Sea. (orig.). 115 figs., 6 tabs.

22067 (HW–78836) **TIMS data processing format definition.** Wallace, D.A. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 4 Sep 1963. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010570. Source: OSTI; NTIS; GPO Dep.

Declassified.

This document defines codes which are for use with the data processing program developed for calculating isotopic analyses from raw data out put of a thermal ionization mass spectrometer.

22068 (INIS-BR–3325) **Coordination symmetry determination of some lanthanide complexes by x-ray diffraction.** Oliveira Paiva Santos, C. de. Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica. 1993. 144p. (In Portuguese). Order Number DE94625179. Source: OSTI; NTIS (US Sales Only); INIS.

The x-ray determination of the crystal and molecular structures of three lanthanide complexes is described. The work is a contribution to the study of the coordination chemistry of lanthanide ions with organic ligands and in particular, it aims to compare the observed point symmetry of the ion environment with spectroscopic predictions. (author).

22069 (INIS-BR–3326) **Geotectonic evolution of granitoid-greenstone belts from Crixas, Guarinos, Pilar de Goias - Hidrolina (Goias), Brazil.** Montalvao, R.M.G. de. Sao Paulo Univ., SP (Brazil). Inst. de Geociencias. 1985. 421p. (In Portuguese). Order Number DE94625130. Source: OSTI; NTIS (US Sales Only); INIS.

The area in discussion, in a geologic context, constitutes one of the most interesting and complex, within the South American Platform, in Brazilian territory, over which granitoid-greenstone belts are outstanding. The Goiano Complex is the oldest unit in the geologic column herein adopted and composed largely of granitoids, gneiss and migmatites, in the amphibolite facies. Dated samples of the complex have shown two isochrones of Rb/Sr reference, the oldest one is 2.926 +- 65 m.y. and the ^{87} Sr/^{86} Sr initial ratio of 0.7001 and the youngest on of 2.471 + 20 m.y. and ^{87} Sr/^{86} Sr initial ratio of 0.701. Although the initial ratios data of the Rb/Sr isochron, as well as the parameters in the Pb/Pb analyses may indicate material of mantle source, it may be interpreted, with the help of field data, that the youngest values may indicate the reworking of crustal sialic rocks formed 2.925 +- 65 m.y. ago (oldest isochron), with primitive material contribution. Before such reworking volcanic-sedimentary sequence was deposited over the already formed sialic crust, and it is denominated Pilar de Goias Supergroup which characterizes the Greenstone Belts in the region. The Archean age for the supergroup was evident through the age results of its ultramafic rocks, showing 2.600 m.y. isochron age, with Sm/Nd methods. Besides the geochronology and field studies, basic information for the construction of the geologic column herein presented, there has been done petrographic and litho geochemical studies, both in the Goiano Complex and Pilar de Goias Supergroup, as for the Pilar de Goias Supergroup, the studies were concentrated on its mafic-ultramafic rocks. (author).

22070 (LBL–35306) **Nonlinear optical spectroscopy for surface studies.** Shen, Y.R. Lawrence Berkeley Lab., CA (United States). Jan 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940142–39: OE/LASE '94: conference on optics, electro-optics, and laser applications in science and engineering, Los Angeles, CA (United States), 22-29 Jan 1994). Order Number DE94011623. Source: OSTI; NTIS; GPO Dep.

Infrared-visible sum-frequency generation as a versatile surface vibrational spectroscopic tool is described. Applications to neat water interfaces and hydrogen adsorption on diamond are used as illustrative examples.

22071 (SAND–94-0057C) **Clustering-based pattern recognition applied to chemical recognition using SAW array signals.** Osbourn, G.C.; Bartholomew, J.W.; Frye, G.C.; Ricco, A.J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406166–2: 1994 solid-state sensor and actuator workshop, Hilton Head, SC (United States), 13-16 Jun 1994). Order Number DE94012070. Source: OSTI; NTIS; GPO Dep.

We present a new patter recognition (PR) technique for chemical identification using arrays of microsensors. The technique relies on a new empirical approach to k-dimensional cluster analysis which incorporates measured human visual perceptions of difficult 2- dimensional clusters. The method can handle nonlinear SAW array data, detects both unexpected (outlier) and unreliable array responses, and has no user-adjustable parameters. We use this technique to guide the development of arrays of thin-film-coated SAW (Surface Acoustic Wave) devices that produce optimal PR performance for distinguishing a variety of volatile organic compounds, organophosphonates and water.

22072 (SAND–94-0240C) **New materials and multidimensional cluster analysis for SAW chemical sensor arrays.** Ricco, A.J. (Sandia National Labs., Albuquerque, NM (United States)); Osbourn, G.C.; Bartholomew, J.W.; Crooks, R.M.; Chuanjing, Xu; Allred, R.E. Sandia National Labs., Albuquerque, NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406166–1: 1994 solid-state sensor and actuator workshop, Hilton Head, SC (United States), 13-16 Jun 1994). Order Number DE94012066. Source: OSTI; NTIS; GPO Dep.

We use six-element arrays of 97-MHz ST-quartz surface acoustic wave (SAW) devices to detect changes in thin-film mass and mechanical properties resulting from sorption of analytes by films representing two new classes of chemical sensor interface: self-assembled monolayers (SAMs) and plasma-grafted films (PGFs). While these materials do not display exceptional chemical selectivity, various combinations of the 7 different SAMs and 8 PGFs examined to produce distinct response patterns for each of 13 analytes. The analytes include aliphatic, aromatic, and chlorinated hydrocarbons; alcohols; ketones; organophosphonates; and water. Evaluation of the SAW array data using multidimensional cluster analysis techniques show that each chemical species can be correctly identified 100% of the time over the 9%- to 49%-of-saturation range using data from many combinations of four or more films.

22073 (SAND–94-0241C) **SAW chemical sensor arrays using new thin-film materials.** Ricco, A.J. (Sandia National Labs., Albuquerque, NM (United States)); Xu, Chuanjing; Crooks, R.M.; Allred, R.E. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940775–1: 5. international meeting on chemical sensors, Rome (Italy), 11-14 Jul 1994). Order Number DE94011940. Source: OSTI; NTIS; GPO Dep.

We have used two classes of materials, self-assembled monolayers (SAMs) and plasma-grafted films (PGFs), as new chemically sensitive layers for an array of 97-MHz surface acoustic wave (SAW) delay-line-based devices. Responses of these materials to each of 14 different analytes, representing the classes of saturated alkane, aromatic hydrocarbon, chlorinated hydrocarbon, alcohol, ketone, organophosphonate, and water, have been evaluated using our six-SAW device array. Results reveal a qualitative "chemical orthogonality" of the films that is very promising for pattern recognition analysis.

22074 (SAND–94-1435C) **Chemical recognition software.** Wagner, J.S.; Trahan, M.W.; Nelson, W.E.; Hargis, P.H. Jr.; Tisone, G.C. Sandia National Labs., Albuquerque, NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404162–2: 1994 caliope interim technical review, Livermore, CA (United States), 26-28 Apr 1994). Order Number DE94012918. Source: OSTI; NTIS; GPO Dep.

We have developed a capability to make real time concentration measurements of individual chemicals in a complex mixture using a multispectral laser remote sensing system. Our chemical recognition and analysis software consists of three parts: (1) a rigorous multivariate analysis package for quantitative concentration and uncertainty estimates, (2) a genetic optimizer which customizes and tailors the multivariate algorithm for a particular application, and (3) an intelligent neural net chemical filter which pre-selects from the chemical database to find the appropriate candidate chemicals for quantitative analyses by the multivariate algorithms, as well as providing a quick-look concentration estimate and consistency check. Detailed simulations using both laboratory fluorescence data and computer synthesized spectra indicate that our software can make accurate concentration estimates from complex multicomponent mixtures, even when the mixture is noisy and contaminated with unknowns.

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Refer also to citation(s) 20663, 20756, 20757, 20783, 20835, 20947, 20980, 21024, 21176, 21230, 21600, 21749, 22013, 22034, 22144, 22145, 22453, 22481, 22750, 23276, 23297

22075 (ANL/CHM/CP–82907) **Waste minimization through microexperimentation: Barriers to implementation.** Gatrone, R.C. Argonne National Lab., IL (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940578–6: Pollution prevention conference, Denver, CO (United States), 3-5 May 1994). Order Number DE94012629. Source: OSTI; NTIS; INIS; GPO Dep.

In the past, synthesis of ligands and extractants for concentrating radwaste, often resulted in generating large amounts of hazardous wastes. Microexperimentation means handling amounts of organics on the scale of millimoles (10^{-3}) to micromoles (10^{-6}). More reliable analytical techniques allow one to obtain data nondestructively on the structure of a molecule on just a few milligrams of material. Obstacles to use of microscale techniques in laboratories include requirement of new, expensive equipment, and resistance of laboratory personnel to new techniques. It is emphasized that in the Argonne laboratory, of the 500 g of an extractant that was required in 1985, nearly 90% was ultimately discarded as waste after 5 years. DOE agreements and other Federal regulations require this be changed.

22076 (ANL/CHM/PP–81023) **Comparison of the crystal structure and molecular models of N,N-diisobutyl-2-(octylphenylphosphinyl)acetamide (CMPO).** Rogers, R.D. (Northern Illinois Univ., DeKalb, IL (United States). Dept. of Chemistry); Rollins, A.N.; Gatrone, R.C.; Horwitz, E.P. Argonne National Lab., IL (United States). [1994]. 41p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013434. Source: OSTI; NTIS; GPO Dep.

The compound crystallizes in the space group $P2_1/c$ with a=13.446(6), b=22.280(7) Å, b=92.07(4)°, and D_{calc}=1.05 g/cm^3 for Z=8 (@20°C). Molecular mechanics, molecular dynamics, and MNDO calculations were also performed on CMPO utilizing the SYBYL^2 suite of programs. Results from these calculations are compared to the crystal structure and to similar calculations performed on CMPO using ALCHEMY. The calculations agree fairly well with the crystal structure.

22077 (ANL/CHM/PP–81877) **Electron-transfer reactions involving two harmonic potentials with a different force constant: The Zusman approach versus the spin-boson model.** Tang, J. Argonne National Lab., IL (United States). [1994]. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013306. Source: OSTI; NTIS; INIS; GPO Dep.

Two approaches: (a generalized spin-boson model with a nonlinear spin-boson coupling and the Zusman's stochastic Liouville formalism) are employed to analyze the electron-transfer reactions involving two harmonic potentials with a different force constant. An analytical rate formula, expressed as a convoluted integral of the individual rate kernel for each mode, is derived with full consideration of quantum tunneling effects. For a dominant solvent mode at low frequency, the formula can be reduced to the results of the Zusman's theory, showing asymmetry of the Marcus rate plot between the normal and the inverted regions.

22078 (ANL/ER/PP–78541) **Correlation between shape resonance energies and C-C bond length in carbon-containing molecules: Elastic electron scattering and carbon K-shell excitation by photons.** Kimura, Mineo (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013310. Source: OSTI; NTIS; GPO Dep.

We document the correlation of shape resonance energies resulting from (i) elastic electron scattering and (ii) carbon K-shell excitation with ic bond order (C-C bond length) for C_2H_2, C_2H_4, C_2H_6, C_3H_8, C_4H_{10}, and C_6H_6. A relationship between K-shell σ resonances and bond length was experimentally pointed out previously. These correlations are qualitatively interpreted to indicate that as molecular size increases (or as bond length increases), the configuration space available for valence electrons increases, reducing energy levels rather uniformly and mowing these correlations to emerge. The similarity of shape resonances in electron scattering and photoexcitation occurs because major events in the

resonances take place slightly outside the molecular field and receive little influence from the inner structure of the molecule.

22079 (ANL/ES/CP–82657) **Scoping economics for the commercial manufacture of metallocene catalysts.** Brockmeier, N.F. Argonne National Lab., IL (United States). 26 May 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405150–1: MetCon '94: worldwide metallocene catalyst/processes conference, Houston, TX (United States), 25-27 May 1994). Order Number DE94011526. Source: OSTI; NTIS; GPO Dep.

This study assumes that commercial-scale production of propylene-based isotactic polymers with metallocene catalyst systems will become a reality. The challenge that must be overcome for commercial success with these propylene polymers is to discover a metallocene system recipe that will give sufficient catalyst activity along with the requisite stereo-selectivity at reasonable cost. Anticipating such a discovery, it is assumed here that the economics are well-represented by a catalyst system that consists in part of a silylene-bridged cyclopentadienyl zirconocene made in a batchwise process having an annual capacity of 15,000 pounds. Activation will be achieved with a cocatalyst such as methylaluminoxane (MAO), coated in conjunction with the catalyst on a support such as silica. The MAO at an estimated $100/lb contributes $1800/lb cost to the finished catalyst with an assumed recipe of 18:1 mass ratio of MAO to zirconocene. Based on a 20% return on investment, the selling price for the supported zirconocene system is estimated to be $2915/lb. The required capital investment to make 735,000 lb/yr of the total supported system is 9 million dollars. These estimates have ±50% range of uncertainty. Payback period for this plant in a sold-out condition is three years. The catalyst system cost in ethylene-propylene copolymer is 3.9 cents per pound with a productivity of 75,000 lb polymer/lb of zirconocene. An Appendix includes some economic details.

22080 (CONF-940414–1) **Effect of temperature on the electron attachment and detachment properties of c-C_4F_6.** Datskos, P.G. (Oak Ridge National Lab., TN (United States)); Christophorou, L.G.; Carter, J.G. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Contract AF 33615-02-C-2221. From 7. international symposium on gaseous dielectrics; Knoxville, TN (United States); 24-28 Apr 1994. Order Number DE94012750. Source: OSTI; NTIS; INIS; GPO Dep.

The temperature dependence of the low-energy electron attachment and autodetachment processes for c-C_4F_6 in a N_2 buffer gas has been studied in the temperature, T, range of 300 to 600 K and the mean electron energy, $<\epsilon>$, range from 0.19 to 1.0 eV. The low-energy electron attachment rate constant for c-C_4F_6 shows only a slight dependence on gas temperature. In contrast, the autodetachment frequency increases by more than four orders of magnitude when T is increased from 300 to 600 K. This increase in autodetachment is due to the increase in the internal energy content of the c-$C_4F_6^-$ anion with increasing T. The autodetachment process under consideration is a heat-activated process and has an activation energy E^* of 0.24 eV. Significance of these results to gaseous dielectrics is indicated.

22081 (DOE/ER/13183–9) **Thermodynamic and kinetic aspects of surface acidity: Progress report, July 1, 1993–June 30, 1994.** Dumesic, J.A. Wisconsin Univ., Madison, WI (United States). Dept. of Chemical Engineering. [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13183. Order Number DE94012351. Source: OSTI; NTIS; GPO Dep.

During the past year, the research involved studies of solid acidity, role of acidity in methylamine synthesis reactions, and catalytic cracking of hydrocarbons. Studies were completed of the acidity of ZSM-5 catalysts, in which effects of non-framework aluminum species on acidity of Broensted acid sites associated with the framework were explored. It was found that microcalorimetric studies of ammonia adsorption at 423 K can be used to determine acid strength distributions of high surface area catalysts. Effects of Sn^{2+} and Sn^{4+} on acid and base sites of alumina were investigated; the former cation neutralizes the acid and base sites. Results of microcalorimetric, infrared spectroscopic, and reaction kinetic studies are being brought together to describe the factors controlling methylamine synthesis and related reactions over acid catalysts. The catalytic cracking studies involved developing a kinetic model for isobutane cracking over acidic Y zeolites.

22082 (DOE/ER/14013–3) **The biochemistry and enzymology of halomethyl corrinoids: Final report.** Hogenkamp, H.P.C. Minnesota Univ., Minneapolis, MN (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14013. Order Number DE94013750. Source: OSTI; NTIS; GPO Dep.

This paper describes efforts aimed at the synthesis, characterization, and properties of fluoromethylcobalamines and other halomethylcorroids.

22083 (DOE/ER/14156–9) **Photodissociation and spectroscopy of gas phase bimetallic clusters: Final report, September 15, 1990–September 14, 1993.** Duncan, M.A. Georgia Univ., Athens, GA (United States). Dept. of Chemistry. [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-90ER14156. Order Number DE94012607. Source: OSTI; NTIS; GPO Dep.

Focus is the study of gas phase metal clusters to evaluate their potential to model fundamental interactions on metal surfaces. Chemical bonding between component atoms in metal clusters and physisorption on cluster surfaces are studied. Electronic spectra, vibrational frequencies, and bond dissociation energies are measured for both neutral and ionized clusters using laser/mass spectrometry. Interest is on bimetallic cluster systems and how they compare to pure metal clusters. The following were studied: Bi/Cr, Bi/Fe, Pb/Sb, Ag_2-rare gas, Ag-Al, Ag-K, Ag-Na, Ag-Li, and Ag_3.

22084 (DOE/ER/14289–2) **An investigation of molybdenum and molybdenum oxide catalyzed hydrocarbon formation reactions: Second period progress report, August 1, 1993–April 1, 1994.** Wisconsin Univ., Milwaukee, WI (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14289. Order Number DE94013700. Source: OSTI; NTIS; GPO Dep.

Equipment construction include: uv source, vacuum system with mass spectrometer, Auger analyzer, fast sample transfer cell, and infrared spectrometer detector. Mo and Mo oxide catalysts were tested for activity for olefin (propylene) metathesis. Higher hydrocarbons were also formed in this reaction in parallel with metathesis products. Surface chemistry experiments were carried out on metallic surfaces in ultrahigh vacuum, photoelectron MoO_2 and its reduction, and $Mo(CO)_6$ adsorption on alumina. Identification of surface species using near-edge x-ray adsorption fine structure is discussed.

22085 (DOE/PC/90042–T9) **Development of a catalyst for conversion of syngas-derived materials to isobutylene: Quarterly report No. 10, July 1, 1993–September 30, 1993.** Barger, P.T. UOP, Inc., Des Plaines, IL (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90042. Order Number DE94013072. Source: OSTI; NTIS; GPO Dep.

Two types of basic metal oxide co-catalysts have been evaluated in combination with CU/Zn/Al oxide methanol synthesis catalyst for the production of isoalcohols, KOH on Al_2O_3 or SiO_2 and alkali metal impregnated Mg/Al MOSSs. Catalytic performance with the K/Al_2O_3 co-catalyst is virtually identical to that of the SiO_2 blank, indicating that this material is inert. In contrast, the K/SiO_2 co-catalyst actually reduces the activity and selectivity of the Cu/Zn/Al methanol synthesis catalyst. Therefore, this approach has been abandoned. Previous testing of Mg/Al MOSS co-catalysts has shown promotion of DME, rather than isoalcohols, presumably by methanol, dehydration on residual acid sites. Addition of 0.2–0.3 wt % alkali (Na, K, and Cs) to the Mg/Al MOSS is not effective for reducing the formation of DME. Attempts to produce isobutanol with Pd/K on Zr/Zn/Mn oxide catalysts, similar to those described by Keim and coworkers, at low pressure conditions have been successful. Catalysts were prepared by the impregnation of Pd (0.15 wt %) from either $PdCl_2$ or $Pd(NO_3)_2$ preformed K/Zr/Zn/Mn oxide.

Materials with two levels of K were also prepared. All of these catalyst show only low activity for syngas to alcohols, with methanol as the only alcohol product. The primary products in these tests are C_{1-4} hydrocarbons. Blank reactor testing has demonstrated that a substantial portion of the light hydrocarbons produced in these 450°C tests are due to reactions on the stainless steel reactor walls and quartz reactor packing material. Attempts to reduce the extent of these side reactions by the use of a porcelain-lined reactor have been unsuccessful.

22086 (DOE/PC/92112–T4) **Novel catalysts for methane activation: Quarterly report No. 5, October 1, 1993–December 31, 1993.** Hirschon, A.S.; Wu, H.J.; Malhotra, R.; Wilson, R.B. SRI International, Menlo Park, CA (United States). 4 Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92112. Order Number DE94013056. Source: OSTI; NTIS; GPO Dep.

The objectives of this project are to test novel fullerene based catalysts for application in methane activation. During this period we investigated a novel method of activating carbon soot which was recently reported in literature. In this method, the soot is treated with carbon dioxide at temperatures of 850°C to give a microporous carbon with a high surface area. We repeated this activation step and found that the BET surface areas increased from approximately 125 m^2/g to over 600 m^2/g. We plan to test this activated soot for methane activation to compare with the results obtained before activation. We continued our investigation of the base-line conditions for both thermal reactions and soot-catalyzed reactions of methane, and in addition, we compared these results to those obtained with Norit-A carbon as a catalyst. Diluents such as hydrogen and helium were added into the reaction system to determine their respective effects on selectivity during the methane activation experiments. In terms of methane activation, under our conditions, the fullerene soot was found to be the most active, with the threshold for the methane activation below as 800°C, while the Norit-A catalyst exhibited a threshold slightly above 800°C, and the pure thermal reaction required temperatures in the range of 900 to 950°C. Under these conditions the selectivity to C_2 was in the reverse order, with the highest selectivity exhibited for the thermal reactions, and the lowest selectivity with the fullerene soot, suggesting that the contact time is essential in order to maximize the selectivity to C_2 hydrocarbons and minimize coke formation. However, we observed interesting results when the diluents were used.

22087 (ECN-RX–93-009) **Thermochemical data for reactor materials and fission products: The ECN database.** Cordfunke, E.H.P.; Konings, R.J.M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Feb 1993. 21p. Order Number DE94774001. Source: OSTI; NTIS.

The activities of the authors regarding the compilation of a database of thermochemical properties for reactor materials and fission products is reviewed. The evaluation procedures and techniques are outlined and examples are given. In addition, examples of the use of thermochemical data for the application in the field of Nuclear Technology are given. (orig.)

22088 (INIS-mf–13876) **Removal of zinc from aqueous solutions by natural bentonite.** Meliah, A. (Centre de Developpement des Materiaux, Algiers (Algeria)); Chegrouche, S.; Malki, H.; Djeddou, R. Secretariat d'Etat a la Recherche, Algiers (Algeria). Jan 1994. 14p. Order Number DE94625202. Source: OSTI; NTIS (US Sales Only); INIS.

The equilibrium isotherms of zinc adsorption onto natural bentonite show that the data correlate well with freundlich and Langmuir's models and that the adsorption is physical in nature. The operating parameters (agitation speed, solid/liquid ratio temperature, particle size and initial zinc concentration) influenced the rate of adsorption. The maximum monomolecular capacity (Q^0) according to the Langmuir model is 52.91 mg. g-1 for an initial zinc concentration of 300 mg. litre-1, At 20^{0}C.

22089 (LA-UR–94-1537) **The solution structure of liquid crystal polymers with small liquid crystal thermoset maleimides and nadimides.** Hjelm, R.P.; Douglas, E.P.; Benicewicz, B.C. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940633–4: 12. symposium on thermophysical properties, Boulder, CO (United States), 19-24 Jun 1994). Order Number DE94013245. Source: OSTI; NTIS; GPO Dep.

The solution structure of the deuterated liquid crystal polyamide polymer (LCP), poly(p-phenylene-2-nitroterephthalamide), alone and mixed with small, rodlike, amide, liquid crystal molecules (LCT) in N-methyl-2-pyrrolidinone (NMP) is studied using small-angle neutron scattering. Measurements were made as a function of LCP concentration using different LCT's mixed at 20 and 40 wt % relative to LCP. The motivation for studying this system comes from a need to connect solution structure with film morphology in processing these materials for high performance molecular composites. The analysis shows that the LCP in NMP forms large domain-like structures. The presence of LCT breaks up the LCP domains into smaller structures, some of which are filamentous, LCP-LCT aggregates. This result suggests that the simple entropic description of solution behavior of mixtures of long and short rods is not adequate in describing systems of this type.

22090 (LA-UR–94-1871) **The hydrogenolysis and isomerization of light hydrocarbons over Pt catalysts.** Anderson, S. (Univ. of New Mexico, Albuquerque, NM (United States). Dept. of Chemical & Nuclear Engineering); Datye, A.K.; Paffett, M.T. Los Alamos National Lab., NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940504–1: 15. conference on catalysis of organic reactions, Phoenix, AZ (United States), 2-5 May 1994). Order Number DE94013142. Source: OSTI; NTIS; GPO Dep.

There is evidence that metallic Pt, unlike Ni and Rh, has the ability to isomerize light hydrocarbons in the presence of hydrogen. The nature of the active site for the isomerization is still unclear though. It has been shown that the morphology of a silica supported Pt particles can be controlled by heating in different atmospheres and that annealing in hydrogen produces cubo-octahedral particles. The reaction of n-butane with H_2 was carried out over two silica supported Pt catalysts of different particle sizes and a Pt(III) single crystal. Comparison of the product distribution between the two supported and the single crystal sample are the focus of this paper.

22091 (LBL–35481) **Quaternary liquid/liquid equilibria of sodium sulfate, sodium sulfite and water with two solvents: Acetone and 2-propanol.** Schiozer, A.L. Lawrence Berkeley Lab., CA (United States). Mar 1994. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94013106. Source: OSTI; NTIS; GPO Dep.

Aqueous solutions of sodium sulfate and sodium sulfite are produced from sodium carbonate in flue-gas scrubbers; recovery of these salts often requires multi-effect evaporators; however, a new energy-efficient unit operation called extractive crystallization has been shown to have reduced energy costs. In this process, an organic solvent is added to the aqueous salt solution to precipitate salt. Acetone is a suitable solvent for this process, better than 2-propanol. Liquid/liquid/solid equilibria for ternary systems containing a salt, water, and an organic solvent were measured. Systems investigated were sodium sulfite/water/acetone and sodium sulfite/water/2-propanol. Experiments were conducted at salt saturation covering a temperature range between the lower consolute temperature and 48.6°C. In the attempt to improve the extractive crystallization process for recovery of sodium sulfate from flue-gas scrubbers, attention was given to a feed containing a mixture of sodium sulfite and sodium sulfate. Liquid-liquid equilibria for quaternary systems containing two salts, water, and an organic solvent were experimentally determined at 35°C. The systems investigated were sodium sulfate/sodium sulfite/water/acetone and sodium sulfate/sodium sulfite/water/2propanol. The systems were studied at three salt ratios. For each salt ratio, experiments were conducted starting at saturation, water was then added until the one-phase region was reached. Mixtures of the two salts proved to have a small disadvantage relative to the 100 % sulfate feed process. Therefore, a sulfate-based extractive crystallization process is recommended.

22092 (LBL–35515) **$CaCl_2$-H_2O in the supercritical and two-phase ranges.** Oakes, C.S. (Lawrence Berkeley Lab., CA (United States)); Pitzer, K.S.; Bodnar, R.J.; Simonson, J.M. Lawrence

Berkeley Lab., CA (United States). Apr 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ; FG05-89ER14065. (CONF-940633–3: 12. symposium on thermophysical properties, Boulder, CO (United States), 19-24 Jun 1994). Order Number DE94013098. Source: OSTI; NTIS; GPO Dep.

Critical temperatures (T_c) and densities ρ_c for aqueous $CaCl_2$ solutions were measured using two different optical techniques. Measurements of $T_c$were made using sealed silica capillaries containing 0.3, 0.5, 1.0 and 2.0 molal $CaCl_2$(aq) solutions. T_c's from these measurements are 661, 666, 678, and 738 K, respectively. Critical temperatures were also determined from measured homogenization temperatures and the observed mode of homogenization (i.e., to the liquid or vapor phase or by fading of the meniscus) in synthetic fluid inclusions. Critical temperatures determined by this method for 1.0, 2.0, and 3.0 molal $CaCl_2$(aq) solutions are 680, 739, and 838 K, respectively. $T_c$for 4.0 molal $CaCl_2$(aq) was found to be in excess of 933 K. Critical pressures (P_c) could not be accurately determined from these measurements but were estimated from another source. Our data are in fair agreement with previously published data at and below 1.0 mol·kg^{-1}. Above 1 mol·kg^{-1}, data from the two published sources of $CaCl_2$(aq) show substantially different trends, with the data from this study agreeing with the more recent of the two reports. Estimated values of ρ_c are given for the solutions examined in the capillary tube experiments. These measurements are based on estimated tube volumes, measured liquid volumes, and solution densities at ambient temperature.

22093 (PNL-SA–24082) **Input and output in chemistry applications.** Kendall, R.A.; Guest, M.F. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940428–4: High performance computing '94: grand challenges in computer simulation, La Jolla, CA (United States), 11-15 Apr 1994). Order Number DE94013435. Source: OSTI; NTIS; GPO Dep.

A discussion of input and output (1/0) requirements for broad classes of computational chemistry applications is presented. An analysis of 1/0 requirements is presented for Hartree-Fock algorithms along with a general description of correlated electronic structure methods. Algorithm comparisons for traditional vector supercomputer and massively parallel processing (MPP) applications are made. Minimal 1/0 performance characteristics for MPP supercomputers are estimated for electronic structure computational chemistry applications.

22094 (SAND–93-2581C) **Theoretical and experimental investigations of fullerene derivatives: $C_{60}H_2$, $C_{60}H_4$, $C_{70}H_2$ and $C_{60}(CH_2)_2$.** Jacobs, S.J. (Sandia National Labs., Albuquerque, NM (United States)); Gillen, K.T.; Cahill, P.A.; Henderson, C.C.; Rohlfing, C.M. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940411–22: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94012727. Source: OSTI; NTIS; GPO Dep.

Hydroboration of C_70 in toluene yields a 2:1 mixture of 1,9-$C_{70}H_2$ and 7,8-$C_{70}H_2$. Equilibration of these two isomers in the presence of a Pt catalyst reveals a free energy difference of 1.4 ± 0.2 kcal/mol. Whereas semiempirical calculations have been found to predict the energy ordering of many fullerene derivatives incorrectly, ab initio Hartree-Fock (HF) calculations have been found to yield quantitative predictions of experiment. The HF/6-31G* level energy separation of 1,9-$C_{70}H_2$ and 7,8-$C_{70}H_2$ of 1.3 kcal/mol is in excellent agreement with experiment. Relative stabilities of isomers of bis(methano)fullerenes were found to parallel those of analogous $C_{60}H_4$ isomers. Density functional theory (DFT) methods have been tested and are equivalent in accuracy to HF methods if similar basis sets are used. $C_{60}H_2$ and $C_{60}H_4$ can be efficiently produced on larger ($\geq$ 50 mg) scales with diimide generated from potassium azodicarboxylate and acetic acid in o-dichlorobenzene.

22095 (SAND–94-0988C) **Formation, structure, and material properties from the reaction product of $M(OCHMe_2)_4$ (M=Ti, Zr) and HOAc.** Alam, T.M. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemistry); Boyle, T.J.; Buchheit, C.D.; Schwartz, R.W.; Ziller, J.W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940411–33: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013774. Source: OSTI; NTIS; GPO Dep.

In an attempt to ultimately control the characteristics of the solutions used for PZT films, we have decided to investigate some of the basic chemistry associated with these mixtures. Frequently these solutions have been generated from Group IV metal alkoxides in acetic acid (HOAc). Therefore, studies of the simple reactivity between $M(OCHMe_2)_4$(M = Ti, Zr) and HOAc have been undertaken. These reactions were monitored by ^1H, ^{13}C, ^{17}O NMR, FT-IR, TGA/DTA, and single crystal X-ray studies. Films were produced by spin-coat deposition of crystalline material (from the titanium reaction) dissolved in toluene and from aged solutions as well.

22096 (SAND–94-1158C) **Preparation of silica or alumina pillared crystalline titanates.** Udomsak, S. (Texas A and M Univ., College Station, TX (United States)); Nge, R.; Dufner, D.C.; Anthony, R.G.; Lott, S.E. Sandia National Labs., Albuquerque, NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940813–4: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94011400. Source: OSTI; NTIS; GPO Dep.

Layered crystalline titanates (CT) [Anthony and Dosch, US Patent 5 177 045 (1993)] are pillared with tetraethyl orthosilicate, 3-aminopropyltrimethoxysilane, and aluminum acetylacetonate to prepare porous and high surface area supports for sulfided NiMo catalyst. Tetra-ethyl orthosilicate or aluminum acetylacetonate intercalated CT are prepared by stepwise intercalation. First, the basal distance is increased by n-alkylammonium ions prior to intercalation with inorganic compounds. However, an aqueous solution of 3-aminopropyltrimethoxysilane could directly pillar CT without first swelling the titanate with n-alkylamine. The catalytic activities for hydrogenation of pyrene of sulfided NiMo supported silica or alumina pillared CT were higher than those of commercial catalysts (Shell324 and Amocat1C). The silicon and aluminum contents of the pillared CT, used as supports, have a considerable effect on the catalytic activities and physical properties of the supports.

22097 (SAND–94-1443C) **Applications of molecular modeling to the design and characterization of materials.** Carlson, G.A.; Faulon, J.L.; Pohl, P.I.; Shelnutt, J.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9310328–1: Science and Technology materials conference, Greensboro, NC (United States), 27-29 Oct 1993). Order Number DE94013343. Source: OSTI; NTIS; GPO Dep.

A variety of new molecular modeling tools are now available for studying molecular structures and molecular interactions, for building molecular structures from simple components using analytical data, and for studying the relationship of molecular structure to the energy of bonding and non-bonding interactions. These are proving quite valuable in characterizing molecular structures and intermolecular interactions and in designing new molecules. This paper describes the application of molecular modeling techniques to a variety of materials problems, including the probable modecular structures of coals, lignins, and hybrid inorganic-organic-organic systems (silsesquioxanes), the intercalation of small gas molecules in fullerene crystals, the diffusion of gas molecules through membranes, and the design, structure and function of biomimetic and nanocluster catalysts.

22098 (SAND–94-8209) **Supercritical water oxidation of colored smoke, dye, and pyrotechnic compositions: Phase 1, Final report.** Rice, S.F.; LaJeunesse, C.A.; Hanush, R.G.; Aiken, J.D.; Johnston, S.C. Sandia National Labs., Livermore, CA (United States). Jan 1994. 62p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE94006620. Source: OSTI; NTIS; GPO Dep.

The US military stockpile has large quantities of obsolete munitions awaiting disposal. Although suitable means for the safe dismantlement of much of this stockpile have been identified, there

are still considerable quantities of specialty materials for which existing methods have been deemed inappropriate from an environmental standpoint. Among these munitions are colored spotting dyes and a wide assortment of pyrotechnics, including colored smokes and flares. In open burn or incineration treatment processes these materials produce large quantities of toxic, and possibly carcinogenic, gases and particulate matter. The U.S Army Armament Research, Development and Engineering Center at Picatinny Arsenal, NJ is interested in developing a method of treatment that will dispose of these munitions without the difficulties identified above. This report examines the feasibility of supercritical water oxidation, an emerging waste treatment technology, to process these materials. Four colored dyes and one pyrotechnic smoke composition were processed in a flow reactor, and the effluent was analyzed to determine the effectiveness of the processing. The tests showed that all of these materials could by oxidized to much less hazardous compounds in less than 10 seconds with a destruction and removal efficiency (DRE) typically > 99.5%. Two technical issues were identified as needing more attention in Phase II of this project: formation of sulfate and chloride salt deposits within the flow reactor and corrosion of the materials of construction.

22099 (UCRL-JC–115810) **The NO to NO_2 conversion by ethylene oxidation.** Marinov, N.M. (Lawrence Livermore National Lab., CA (United States)); Steele, R.C.; Malte, P.C.; Hori, M. Lawrence Livermore National Lab., CA (United States). 13 May 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940711–14: 25. international symposium on combustion, Irvine, CA (United States), 31 Jul - 5 aug 1994). Order Number DE94012887. Source: OSTI; NTIS; GPO Dep.

A well-stirred reactor experiment and chemical kinetic modeling effort were performed in order to study the effect of ethylene oxidation on the conversion of nitric oxide (NO) to nitrogen dioxide (NO_2). Parameters examined in this study were temperature (1003–1260K) and input hydrocarbon concentration (220–3270 ppmv wet). The stirred reactor residence time was maintained at ~2 milliseconds. Kinetic calculations indicated the NO to NO_2 conversion proceeded through the "HO_2 mechanism", NO + HO_2 → NO_2 + OH, and the majority of the conversion occurred within the well-stirred reactor. The chemical kinetic mechanism used to model the percent conversion of the NO to NO_2, C_2H_4, CH_4, CO and CO_2 concentrations showed excellent agreement with the experimental data, thereby validating the ethylene oxidation mechanism. Reaction pathway analysis and logarithmic sensitivity analysis were combined to analyze the ethylene oxidation structure and HO_2 production process. The analysis revealed the primary ethylene oxidation pathway has the potential to form two HO_2 radicals per ethylene consumed, thus making the ethylene a significant agent in promoting conversion of NO to NO_2. The secondary ethylene oxidation pathway is a potent chain branching process which furthers ethylene consumption and HO_2 production.

4004 Electrochemistry

Refer also to citation(s) 20686, 21300, 21947

4005 Photochemistry

Refer also to citation(s) 20686, 20781, 22101, 22146, 22147

22100 (ANL/CHM/PP–77910) **Photochemistry without protons: Radical cation chemistry in zeolites.** Trifunac, A.D.; Barnabas, M.V. Argonne National Lab., IL (United States). Chemistry Div. [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012631. Source: OSTI; NTIS; GPO Dep.

The interconversion of the C_7H_8 molecular framework, especially norbornadiene (NBD) and quadricyclane (Q), has been considered for photochemical energy storage. Actually, very little was known about the details of these carbon-skeleton transformations, and only one radical cation species ($NBD^{+\cdot}$) was characterized. The authors have undertaken a thorough study of these systems using zeolite matrices. They have shown that zeolites have exceptional properties, allowing unprecedented control of chemical reactivity. In the attached scheme, they outline some of the species they were able to characterize. The crucial aspect of the zeolite matrix is that one can tune the matrix-radical cation interaction by varying the matrix polarity. The ZSM-5 zeolites of identical structure with different Si/Al ratio are ideally suited for such study. Without discussing all the transformations, the authors point that several processes, such as the reverse Diels-Alder reaction are known to occur by involvement of highly excited states. Such reactions in zeolites means that sites in the zeolite matrix are able to stabilize high electronic states of ions, significantly lowering the potential energy barrier for such reactions. Thus, they are able to thermally drive otherwise photodriven reactions.

22101 (DOE/ER/13937–6) **Laser enhanced chemical reaction studies: Technical progress report.** Flynn, G. Columbia Univ., New York, NY (United States). Dept. of Chemistry. 31 Dec 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13937. Order Number DE94013489. Source: OSTI; NTIS; GPO Dep.

A powerful infrared diode laser probe was used to determine final states of small (2-5 atom) molecules produced by collisions, photofragmentation, or chemical reactions with spectral resolution 0.0003 cm^{-1} and time resolution 10^{-7}s. Besides picturing the vibrational rotational quantum states of product molecules, this also provides a picture of the translational motion of recoiling fragments through the infrared Doppler line width profile. This method was used to probe collisions between cool bath molecules and vibrationally hot molecules, in order to understand the quenching mechanism for unimolecular chemical reactions. Long-range collisions appear to dominate production of bath molecules which become vibrationally excited during this quenching process. Glimpses are being provided of the separate behavior of translational and rotational degrees of freedom of recoiling bath molecules during relaxation of highly vibrationally excited donors. A study was completed of collisions between hot H atoms and CO_2, by measuring probability for excitation of the antisymmetric vibrational overtone level $CO_2(00^02)$. Comparison with a 00^01 fundamental level study suggests that translational and rotational energy distributions in this collision can be described by classical mechanics, but that vibrational excitation probabilities require full quantum treatment. Relaxation of hot pyrazine by CO_2 was studied. Multiphoton ionization studies have been begun.

4006 Radiation Chemistry

Refer also to citation(s) 20958

22102 (DOE/ER/00038–3705) **Radiation Laboratory, University of Notre Dame quarterly report, January 1–March 31, 1994.** Notre Dame Univ., IN (United States). Radiation Lab. 25 May 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76ER00038. (NDRL–3705; Q–147). Order Number DE94011585. Source: OSTI; NTIS; GPO Dep.

39 abstracts are presented of research projects in radiation chemistry, photochemistry, and related subjects.

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 21603, 22058, 22063, 22064, 22168, 22169, 22170

22103 (ANL/CHM/PP–77911) **Preparation of unsymmetrically labeled oxygen molecules and their use of elucidate oxygen metabolism.** Appelman, E.H. (Argonne National Lab., IL (United States)); Ogura, T.; Kitagawa, T.; Varotis, C.; Yong Zhang; Babcock, G.T. Argonne National Lab., IL (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012632. Source: OSTI; NTIS; INIS; GPO Dep.

A novel technique has been developed to synthesize in large quantities an O_2 molecule that is unsymmetrically labeled with the oxygen isotopes oxygen-16 and oxygen-18. This unusual molecule, $^{16}O^{18}O$, has been utilized as a unique spectroscopic probe of the mechanism of metabolism in living organisms. Preparation of this

molecule requires prior synthesis of the exotic precursor hypofluorous acid, HOF, and an improved method for synthesizing this precursor has recently been developed that permits the preparation of essentially unlimited quantities of the labeled oxygen. This, in turn, has made it practical to use this oxygen in Raman-spectroscopic studies of the mechanism by which O_2 is reduced by the enzyme cytochrome oxidase, a key step in the metabolic utilization of oxygen by living organisms. The results indicate that the interaction of O_2 with the iron of the enzyme may be represented: $Fe^{2+} + O_2 \rightarrow Fe^{2+}\text{-}O_2 \rightarrow Fe^{3+}\text{-}OOH^- \rightarrow Fe^{4+} = O \rightarrow Fe^{3+}\text{-}OH^-$.

22104 (ANL/TD/CP–82063) **TIARA analysis of tritium inventory in Li_2O.** Billone, M.C. Argonne National Lab., IL (United States). May 1994. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–3: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94012643. Source: OSTI; NTIS; INIS; GPO Dep.

The TIARA code has been developed to predict tritium inventory in Li_2O breeder ceramic and to predict purge exit flow rate and composition under steady-state operating conditions. Inventory predictions are based on models for bulk diffusion, surface desorption, solubility and precipitation. Parameters for these models are determined from the results of laboratory annealing studies on unirradiated and irradiated Li_2O and from a limited number (2) of inventory data measured after in-reactor purge-flow testing. The remaining inventory data points (18) are used for code validation. In the validation exercise, models and model parameters are fixed to assess how well TIARA predictions agree with data. On the average, the TIARA predictions are in excellent agreement with the inventory data from the following in-reactor tests: EXOTIC-2, SIBELIUS, VOM-15H, CRITIC-1, BEATRIX-II (Phase 1) thin ring, and BEATRIX-II (Phase 1) thick pellet. Thus, TIARA can be used with a reasonable degree of confidence for design analysis over a broad range of fabrication variables and steady-state operating conditions.

22105 (CNIC–00740) **Study on counter current extraction process of high enriched uranium.** Wang Jianchen (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Jiao Rongzhou; Liu Bingren; Wang Sulan. China Nuclear Information Centre, Beijing, BJ (China). Jun 1993. 13p. (In Chinese). (TSHUNE–0063.). Order Number DE94625261. Source: OSTI; NTIS (US Sales Only); INIS.

The counter current extraction process of high enriched uranium with critically safe mixer-settler has been studied. The distribution curves of acidity and uranium in stages have been obtained. The results fitted well with test tube extraction cascade experiments. The interface height and the ratio of the contact phases have been determined. The height of liquid surface was lower than the critically safe limit during the operation. The recovery of uranium is greater than 99.9%, and the extraction efficiency of stage in 1 A mixer-settler is better than 85%.

22106 (CNIC–00744) **Removal of strontium from high-level radioactive waste with crown-ether extraction.** He Longhai (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology); Wong Ximei; Yang Dazhu; Jiao Rongzhou; Song Chongli. China Nuclear Information Centre, Beijing, BJ (China). Jul 1993. 10p. (In Chinese). (TSHUNE–0066.). Order Number DE94625262. Source: OSTI; NTIS (US Sales Only); INIS.

The removal of strontium from HLW (high-level radioactive waste) with the extraction by dicyclohexano-18-crown-6 (DC18C6) in 1-octanol has been investigated. The distribution coefficients of Sr^{2+} and the ions of Na^+, K^+, Cs^+, Ni^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+} and Mo^{6+} in DC18C6-1-octanol-HNO_3 were determined. Results showed that DC18C6 has a high selectivity of extraction for Sr. The most cation ions in the waste solution are not extractable, except for K^+ and Mo^{6+}. The Al^{3+} and Fe^{3+} have a strong salt-out effect on the extraction of Sr^{2+}. Na^+ has the same effect as Al^{3+} and Fe^{3+} at low acidity, but has some competitive effect on the extraction of Sr at high acidity. A new process for the removal of Sr from acidic HLW has been built and batch counter current experiment with synthetic HLW solution was carried out. Through the process with three extraction stages, one scrub stage and four strip stages, 99% of Sr was removed from the feed and the amount of Sr was enriched from 0.6% in the feed to 76% product. This process is simple and high selectivity. It can be used for removal or recovery of Sr from HLW.

22107 (DOE/ER/61006–3) **Synthesis of tracers using automated radiochemistry and robotics: Final progress report, August 1, 1990–October 31, 1993.** Dannals, R.F. Johns Hopkins Univ., Baltimore, MD (United States). Div. of Nuclear Medicine. Jan 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61006. Order Number DE94011577. Source: OSTI; NTIS; INIS; GPO Dep.

The synthesis of high specific activity radiotracers labeled with short-lived positron-emitting radionuclides for use in positron emission tomography (PET) often requires handling large initial quantities of radioactivity for a successful tracer preparation and PET study. High specific activities are required when preparing tracers for use in PET studies of neuroreceptors, which are small biomacromolecular recognition sites that are finite in number and easily saturated. With the current demands for production of radiotracers for PET, a fully automated approach for tracer synthesis is highly desirable. This proposal involves the development of a system for the Synthesis of Tracers using Automated Radiochemistry and Robotics (STARR) for this purpose. While the long range objective of the proposed research is the development of a totally automated radiochemistry system for the production of major high specific activity II C-radiotracers for use in PET, the specific short range objectives of the proposed research are the automation of ^{11}C-methyl iodide ($^{11}CH_3I$) production via an integrated approach using both radiochemistry modular labstations and robotics, and the extension of this automated capability to the production of several radiotracers for PET.

22108 (FZR–32) **Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.** Johannsen, B. (ed.). Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The subjects of the present report are described in this volume in 41 reports dealing with various aspects of radiotracers for nuclear medicine. This first part describes synthetic work on ^{11}C-tracers and precursors. The papers on technetium/rhenium chemistry describes the efforts to gain a deeper insight into the reactions taking place in intricate Tc/Re-ligand systems, to design more suitable and variable chelate units, and to start functionalizing these complexes in order to make them mimics of biochemical substrates or drugs. Progress has been achieved in the complexation of SH-containing peptides, mainly by the introduction of N-alkylation, which remarkably influences the properties of the complexes, by systematic alteration of the peptide chain length and derivatization. (orig./EF)

22109 (FZR–32, pp. 4-6) **Substances labelled in metabolically stable positions. Pt. 2: The synthesis of 1-^{11}C-nitrobenzene.** Maeding, P.; Steinbach, J.; Kasper, H.; Fuechtner, F. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication NITROBENZENE/synthesis; NITROBENZENE; SYNTHESIS; CARBON 11; LABELLING; LIQUID COLUMN CHROMATOGRAPHY; RADIOCHROMATOGRAPHY; RADIOCHEMICAL ANALYSIS

22110 (FZR–32, pp. 7-9) **Substances labelled in metabolically stable positions. Pt. 3: The synthesis of 1-^{11}C-aniline - a ^{11}C-ring-labelled synthone.** Maeding, P.; Steinbach, J.; Kasper, H. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The synthesis of ^{11}C-ring-labelled substances such as phenylalanine is the reduction of 1-^{11}C-nitrobenzene to ^{11}C-ring-labelled aniline. The appropriate diazonium salt is chosen to be the labelled synthone for further reactions. (orig./EF)

22111 (FZR–32, pp. 10-13) **Substances labelled in metabolically stable positions. Pt. 4: Precursor synthesis for ^{11}C-ring-labelled pyridine derivatives.** Chebani, K.; Maeding, P.; Habicher, W.D.; Steinbach, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Heterocyclic compounds, in particular derivatives of pyridine, participate in biological processes such as redox reactions. Appropriate labelled compounds could be useful for tracer studies. Within the framework on metabolically stable ^{11}C-labelled cyclic compounds, such as aromatics, the generation of ^{11}Cpyridine derivatives is the first attempt to synthesize such heterocyclic tracers. (orig./EF)

22112 (FZR–32, pp. 14-17) **Setting up an apparatus for routine preparation of ^{18}FFDG.** Fuechtner, F.; Steinbach, J.; Loesel, E.; Luecke, R. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The most widely used radiopharmaceutical in positron emission tomography (PET) studies is 2-^{18}Ffluoro-2-deoxy-D-glucose (^{18}FFDG). The ^{18}FFDG-preparation device consists of two main parts, the processing unit, situated inside the hot cell and its control unit. A pump, the radiation monitors and a recorder are additionally used. All parts of the processing unit, such as the reaction vessel, purification columns, electro-magnetic and electric stream selection valves, fittings, tubes, a waste absorber, electrical and tube connectors, conductivity cells, radioactivity monitors (Geiger-Mueller tubes, 70034, VacuTec) and the manometer, are mounted on a stainless steel housing. The processing unit is remote controlled by the control unit via a common 24-wire cabel. The tubes for the target gas, the compressed N_2 (for delivering the liquids), and the vessels containing the liquids needed for the synthesis, are connected to the synthesis unit by PTFE tubing and luer adapters. (orig./EF)

22113 (FZR–32, pp. 17-23) **Determination of the chemical and radiochemical purity and specific radioactivity of ^{18}FFDG by HPLC.** Fuechtner, F.; Neubert, K.; Steinbach, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

High performance liquid chromatography (HPLC) in combination with the radioactivity detection is the best control method for the radiochemical purity of ^{18}FFDG. An anion exchange separation mechanism allows isocratic separation of carbohydrates. Using a strong basic eluent, the weakly acid carbohydrates form anions and are therefore retained on the anion exchange resin. The chemical and radiochemical purity and specific radioactivity can be determined simultaneously by including in the chromatographic system a mass detector sensitive, enough for quantitative determination of the product species. (orig.)

22114 (FZR–32, pp. 23-25) **Determination of the specific activity of ^{123}INal.** Kretzschmar, C.; Scholz, R.; Fuechtner, F.; Steinbach, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The new method described enables us to determine radiochemical purity as well as specific activity. For this purpose the chromatographically determined iodine content of the solutions has to be quantified. The use of reference solutions of known iodine concentrations makes it possible to determine the iodine content in real ^{123}INal solutions in g/l. (orig.)

22115 (FZR–32, pp. 25-27) **A new labelling method for L-3-α-methyltyrosine.** Kretzschmar, C.; Scholz, R.; Steinbach, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication METHYL TYROSINE/labelling; IODINE 123/isotopic exchange; LABELLING; RADIOCHEMICAL ANALYSIS; CHEMICAL REACTION YIELD

22116 (FZR–32, pp. 37-39) **Technetium and rhenium complexes derived from spiperone. Pt. 1: Synthesis of a 4-fluorobutyrophenone-containing neutral rhenium complex.** Spies, H. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Noll, S.; Noll, B.; Klostermann, K. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations have therefore been undertaken to synthesize Tc and Re complexes showing structural analogies to the D_2 receptor-binding ligand spiperone and to study their binding affinity. (orig.)

22117 (FZR–32, pp. 40-42) **Technetium and rhenium complexes derived from spiperone. Pt. 2: X-Ray crystal structure of (3-thiapentane-1.5-dithiolato)(p-fluorophenyl-1-oxobutanethiolato-4)-oxorhenium(V)** Spies, H. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Leibnitz, P.; Noll, S.; Noll, B. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication TECHNETIUM COMPLEXES/crystal structure; RHENIUM COMPLEXES/bond lengths; BOND ANGLE; MOLECULAR STRUCTURE; X-RAY DIFFRACTION; SPIPERONE

22118 (FZR–32, pp. 43-48) **Technetium and rhenium complexes derived from spiperone. Pt. 3: Biological evaluation of a 4-fluorobutyrophenone-containing neutral rhenium complex.** Syhre, R.; Wenzel, U.; Berger, R. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The first Re-coordinate compound is at present ready for use in biological screening. The structure of this complex shows similarity to the dopamine D_2 receptor binding ligand spiperone. In the preliminary experiments it shall be tested whether this substance has an influence on the uptake of 3H-spiperone into rat brain sections. The precursors have also been investigated in comparison with the test substance to recognize possible effects caused by the partial structures of the molecule. (orig./EF)

22119 (FZR–32, pp. 48-52) **N-alkylated mercaptoacetyl glycine derivatives as multipurpose ligands in radio tracer design. Pt. 1: Synthesis of ligands.** Noll, S. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Noll, B.; Spies, H.; Johannsen, B. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

N-alkyl-MAG_n ligands were prepared by reaction of the various chloroacetylamino acids or chloroacetyl peptides with the required alkyl amines to give the N-alkyl glycines. (orig.)

22120 (FZR–32, pp. 53-59) **N-alylated mercaptoacetyl glycine derivatives as multipurpose ligands in radio tracer design. Pt. 2: Formation and biodistribution of technetium complexes.** Noll, B. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Noll, S.; Spies, H.; Johannsen, B. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.*

171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

N^1-alkylated mercaptoacetyl glycine ligands were labelled with technetium-99m and the formed products analyzed by chromatographic methods. Biodistribution patterns of the resulting species were determined in Wistar rats. The compounds were tested with regard to their ability to be accumulated in arterioclerotic plaques. (orig.)

22121 (FZR–32, pp. 59-60) **Ligand exchange reaction of technetium gluconate with mercaptoacetyl glycine (MAG_1) and n-methyl mercaptoacetyl glycine (CH_3-MAG_1).** Noll, B.; Johannsen, B.; Noll, S.; Spies, H. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication TECHNETIUM COMPOUNDS/chemical preparation; TECHNETIUM 99; LABELLING; THIN-LAYER CHROMATOGRAPHY; ULTRAVIOLET SPECTRA; GLUCONIC ACID; ORGANIC SULFUR COMPOUNDS

22122 (FZR–32, pp. 61-63) **Synthesis and X-ray crystal structure of $AsPh_4ReO(MAG_2)$.** Noll, B. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Leibnitz, P.; Noll, S.; Johannsen, B. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The Re complex of the S, N, N, O-ligand mercaptoacetyl diglycine (MAG_2) was prepared and characterized by X-ray structure determination. The complex was isolated as tetraphenylarsonium salt and identified by elemental analysis, ^1H NMR, and infrared spectroscopy. (orig./EF)

22123 (FZR–32, pp. 66-69) **A new oxorhenium(V) complex containing a stable rhenium-chlorine bond. X-ray structure analysis of (3-thiapentane-1,5-dithiolato)(chloro)oxorhenium(V).** Fietz, T. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Spies, H.; Pietzsch, H.J.; Klostermann, K.; Scheller, D. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication RHENIUM COMPLEXES/structural chemical analysis; CHLORINE COMPOUNDS; ORGANIC SULFUR COMPOUNDS; X-RAY DIFFRACTION; ULTRAVIOLET SPECTRA; CHEMICAL REACTION YIELD; NMR SPECTRA; MASS SPECTROSCOPY; MOLECULAR STRUCTURE

22124 (FZR–32, pp. 70-74) **Trichlorobis(triphenylphosphane)rhenium(III) complexes containing one isocyano ligand.** Glaser, M. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Spies, H.; Hahn, F.E.; Scheller, D. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication RHENIUM COMPLEXES/chemical preparation; RHENIUM COMPLEXES/crystal structure; X-RAY EMISSION ANALYSIS; INFRARED SPECTRA; BOND LENGTHS; BOND ANGLE; NMR SPECTRA; X-RAY DIFFRACTION; ULTRAVIOLET SPECTRA; MOLECULAR STRUCTURE

22125 (FZR–32, pp. 74-78) **Rhenium complexes with tris-(2-thiolatoethyl)amine.** Spies, H. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Glaser, M.; Hahn, F.E. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The chemistry of technetium and rhenium tracers can be considered to be mainly a chemistry of oxo compounds. In order to gain access to alternative 'oxo-free' metals capable of being coupled to anchor groups, on complex formation studies were carried out with a tripodal tetradenate 'umbrella ligand' which to correspond with a monodentate neutral ligand in trans-position. (orig.)

22126 (FZR–32, pp. 78-81) **Technetium and rhenium complexes with thioether ligands. Pt. 4: Synthesis and structural characterization of neutral binuclear oxorhenium(V) complexes with bidentate thioethers.** Pietzsch, H.J. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Spies, H.; Klostermann, K.; Leibnitz, P.; Reck, G.; Beger, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

In view of the fact that the rhenium nuclides ^{186}Re and ^{188}Re emit β^-particles with therapeutically useful energies, rhenium is included in our efforts to evaluate novel thioether complexes as potential tracers for radiodiagnostic and radiotherapeutic purposes. (orig.)

22127 (FZR–32, pp. 82-86) **Technetium and rhenium complexes with thioether ligands. Pt. 5: Synthesis and structural characterization of neutral oxorhenium(V) complexes with potentially tetradentate thioethers.** Pietzsch, H.J. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Spies, H.; Klostermann, K.; Leibnitz, P.; Reck, G.; Beger, J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Ligand exchange reaction of the potentially tetradentate ligand 1,8-dihydroxy-3,6-dithiaoctane ('$S_2(OH)_2$') with $ReOCl_4$- leads to the formation of a violet microcrystalline compound which precipitates from the reaction mixture. (orig.)

22128 (FZR–32, pp. 87-91) **Electrochemical investigations into rhenium(V) thioether complexes.** Hoffmann, I.; Pietzsch, H.J. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Rhenium complexes of the general formula $Re_2O_3X_4(L)_4$ are known with several ligands L, and electrochemical studis have been carried out, for examples, with complexes where L=pyridine. Analogous rhenium complexes with thioethers have now been prepared by us. Their electrochemical behaviour was characterized by cyclic voltammetry, d.c. polarography and coulometry. Special attention was devoted to similarities and differences between Re-S-(thioether)- and Re-N-(pyridine) compounds. (orig.)

22129 (FZR–32, pp. 91-95) **Rhenium(V) complexes with meso-DMSA. Pt. 3: $Ph_4AsReO(DMSA)_2$x 2 acetone and identification of the possible isomers.** Seifert, S.; Spies, H.; Leibnitz, P.; Reck, G. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The crystal structure of the complex under investigation shows hydrogen bonds between the acetone molecules and the carboxylic acid groups on the one side and between the carboxylic acid groups of two molecules on the ohter. The distances of the O–H contacts are slightly longer (2.605-2.691 A) than described for the $Et_4NReO(DMSA)_2$ complex. (orig.)

22130 (FZR–32, pp. 95-99) **Preparation and characterization of nitridorhenium(V) DMSA complexes.** Seifert, S.; Schneider, F.; Pietzsch, H.J.; Spies, H. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The studies involve preparation of ReN-DMSA and ReN-DMS ester complexes as well as spectroscopic and chromatographic chracterization and elemental analysis. (orig.)

22131 (FZR–32, pp. 100-102) **Technetium(V) complex with meso-2,3-dimercaptosuccinic acid monohexylester for arteriosclerotic plaque accumulation.** Noll, B. (Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie); Pietzsch, H.J.; Spies, H.; Dinkelborg, L. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Proceeding from the assumption that the presence of carboxylic group and a longer alkyl chain in the ligand molecule of complexes fulfil the requirements of arteriosclerotic plaque accumulation, the complexation reaction of 2,3-dimercaptosuccinic acid (DMSA) monohexyl ester with technetium and the biodistribution of the resulting product were investigated. (orig.)

22132 (FZR–32, pp. 103-106) **Ester-bearing oxorhenium(V) complexes - synthesis, characterization and reactions.** Spies, H. (Technische Univ. Dresden (Germany). Inst. fuer Analytische Chemie); Fietz, T.; Pietzsch, H.J.; Scheller, D. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

This article describes the preparation and characterization of a series of rhenium complexes as substrates for hydrolysis experiments with esterases. The neutral oxorhenium (V) compounds contain mercaptoacetic and thiomalic acid esters as constituents. The alcohol component is systematically altered from C_1 to C_6. (orig.)

22133 (FZR–32, pp. 106-110) **Hydrolysis studies of ester substituted oxorhenium(V) complexes.** Seifert, S.; Syhre, R.; Fietz, T.; Spies, H. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

The investigated complexes with one ester group at the monodentate mercaptoacetic acid ligand are hydrolysed by enzymes. Differences in the kinetics of the enzymatic hydrolyses studied in rat plasma, human plasma and pig liver esterase point to species-related differences between the enzyme systems used. (orig./EF)

22134 (FZR–32, pp. 110-112) **The labelling yield of the technetium-MAG_3 as a function of the content of mercaptoacetyl triglycine disulphide in the MAG_3 kit.** Noll, B.; Noll, S.; Grosse, B.; Landrock, K.; Teich, A.; Spies, H.; Johannsen, B.; Muth, O.; Jantsch, K. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication TECHNETIUM COMPOUNDS/labelling; LABELLING; YIELDS; IMPURITIES; RADIOPHARMACEUTICALS; TECHNETIUM 99; POLAROGRAPHY; LIQUID COLUMN CHROMATOGRAPHY

22135 (FZR–32, pp. 112-114) **An efficient HPLC-method for determination of the chemical purity of HM-PAO ligand and kit preparations.** Seifert, S.; Schneider, F. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication TECHNETIUM COMPOUNDS/impurities; TECHNETIUM COMPOUNDS/ligands; LIGANDS/impurities; IMPURITIES; LIGANDS; LIQUID COLUMN CHROMATOGRAPHY; NMR SPECTRA; CARBON 13; NUCLEAR MEDICINE; RADIOPHARMACEUTICALS; QUALITY ASSURANCE; QUALITY CONTROL

22136 (FZR–32, pp. 114-117) **Polarographic determination of tin(II) in HMPAO kits.** Hoffmann, I. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Stannous chloride is an essential constituent in kits for preparation of ^{99m}Tc-HMPAO. Its content is very low. Each kit vial contains 5 .. 7.6 μg stannous chloride. Because the quality of the radiopharmaceutical depends very much on the availability of 'effective' stannous ions, a sensitive method is needed for selective determination of Sn(II) as distinct from Sn(IV). While general methods are available to determine the total of the stannous and stannic content, electrochemical methods are preferred because they make it possible to discriminate between the oxidized and reduced forms. (orig.)

22137 (FZR–32, pp. 142-146) **Suitability of incubation of rat brain sections for evaluation of potential dopaminergic Re- or Tc-coordination compounds.** Wenzel, U.; Syhre, R.; Berger, R.; Bergmann, R. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

In the present study we use in vitro incubation of brain sections. The advantages of this method are that it requires only minimal amounts of radioactive material and a very small number of test animals. The method was calibrated using ^{3}Hspiperone as the ligand and (+)butaclamol as a displacer. At the moment only non-radioactive Re complexes are available. Indications concerning any specific binding of Re-coordination compounds to D_2 receptors are therefore gained indirectly derived from competition with labelled spiperone, compared with the effect of (+)butaclamol. (orig.)

22138 (FZR–32, pp. 146-150) **Relations between the uptake of the radiometal ^{169}Yb into normal and tumour cells and their metabolic activity depending on the ligand species.** Kampf, G. (Univ. Clinics, Clinic of Nuclear Medicine, Dresden Technical Univ. (Germany)); Knop, G.; Matys, S.; Kunz, G. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

This study is aimed at detecting a relation between the metabolic activity of cells and their M^{3+} uptake using complexes with various ligands. (orig.)

22139 (FZR–32, pp. 150-152) **Influence of the stability of ^{169}Yb ligand complexes on the uptake of the metal nuclide in cultured cells.** Kampf, G. (Univ. Clinics, Clinic of Nuclear Medicine, Dresden Technical Univ. (Germany)); Knop, G.; Matys, S.; Kunz, G. Forschungszentrum Rossendorf e.V. (FZR) (Germany). Inst. fuer Bioanorganische und Radiopharmazeutische Chemie. Feb 1994. In *Institute of Bioinorganic and Radiopharmaceutical Chemistry. Annual report 1993.* 171p. Order Number DE94773569. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication YTTERBIUM COMPLEXES/uptake; YTTERBIUM COMPLEXES/stability; UPTAKE; STABILITY; LIGANDS; CELL CULTURES; EVALUATION

22140 (HW–58240) **The recovery of gross and mixed fission products at Hanford.** Coppinger, E.A.; Judson, B.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Dec 1958. 20p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012011. Source: OSTI; NTIS; GPO Dep.

Declassified.

This report presents preliminary engineering analyses of costs and possible capabilities for recovering gross and mixed fission products at Hanford. Three alternates were considered for recovering gross or mixed FP from Purex 1WW in B Plant: gross FP recovery as an individual total program, gross FP recovery as an incremental part of a waste solidification program, and recovery of a mixture of zirconium-95 and niobium-95 as an individual total program.

22141 (HW–80927-8) **Monthly report of radioisotopes research and development, Hanford Laboratories: August 1964.** Walling, M.T. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1964. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012099. Source: OSTI; NTIS; GPO Dep.

Declassified.

Candidate canning materials were tested in contact with molten stand-ins for Pm metal; nondestructive tests were conducted. Related studies included americium processing, uranium-233 support, Ce-Pm separation, and technetium analyses.

22142 (INIS-BR–3316) **Spiperone dithiocarbamate- ^{99m}Tc kit - a potential diagnosis agent for dopaminergic D-2 brain pathologies - biodistribution.** Goncalves, M.M. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1993. 88p. (In Portuguese). Order Number DE94625271. Source: OSTI; NTIS (US Sales Only); INIS.

Psycho pharmacology has been discovering much about the D 2 dopamine receptors and their interrelationship to brain pathologies such as Parkinson's Disease, Schizophrenia and Huntington Disease. Those biological receptors have got affinity with dopamine endogenous agent, so that they complex and, in non pathological individuals, the biological receptors contribute to bring the levels of dopamine and free acetylcholine into equilibrium. The Spiperon Dithiocarbamate (SPDC) from Spiperon is synthesized and its complexation with Technetium-99 m has been prepared with its reaction parameters after being studied and improved. The SPDC-^{99m} Tc complex biological distribution has been made in Wistar rats and the uptake of spleen, heart, liver, stomach, lung, kidney, blood, intestine and brain have been resolved. The plasmatic clearance curve has been based on Wistar rats data and the Know-how of the kit (for label SPDC with ^{99m} Tc) has been achieved. (author).

22143 (KFK–5301) **Thermodynamical behaviour of neptunium(V) in concentrated NaCl and $NaCl_4$ solutions.** Neck, V.; Kim, J.I.; Kanellakopulos, B. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Heisse Chemie. Feb 1994. 43p. (In German). Order Number DE94773752. Source: OSTI; NTIS (US Sales Only); INIS.

In the present work, the chemical behaviour of Np(V) is investigated in concentrated NaCl and $NaClO_4$ solutions and the differences in thermodynamical properties are examined. Spectrophotometrical investigations clearly demonstrate the formation of Np(V) chloro complexes in solutions of high chloride ion concentrations. Quantitative investigations on the chloride complexation behaviour of the NpO_2^+ ion have been carried out applying a solvent extraction method with sodium dinonyl naphthalene sulfonate (NaDNNS) as ion exchanging extractant. At constant ionic strength I=5 M ($NaClO_4$/NaCl) the formation constants of the species NpO_2Cl and NpO_2Cl_2 have been found to be $\beta'_1=0.90\pm0.05$ and $\beta'_2=0.20\pm0.02$, respectively. Furthermore, the solvent extraction method with NaDNNS has been used in order to determine mean activity coefficients of the NpO_2^+ ion, dissolved in trace concentrations, and the anion of the salt solutions. The consequences of chloride complexation on the pH-dependent solubility behaviour of Np(V) has been investigated under atmospherical carbon dioxide partial pressure (0.03% CO_2 in Ar). In the region of low carbonate concentrations (pH<9), solubility in 5 M NaCl significantly overceeds the value in noncomplexing $NaClO_4$ solution. The difference is more than an order in magnitude. With increasing carbonate concentration, the carbonate complexes NpO_2CO_3, $NpO_2(CO_3)_2^{3}$ and $NpO_2(CO_3)_3^{5}$ are formed in both media. As a consequence, the solubility increase due to chloride complexation becomes less significant, particularly when the third carbonate complex becomes the predominant species in solution. The hexagonal bypyramidal structure of the complex $NpO_2(CO_3)_3^{5}$ does not allow additional complexation with chloride ions. (orig.)

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Refer also to citation(s) 20732, 21595, 22098, 22100, 22452, 22774, 23276

22144 (ANL/CHM/CP–80988) **Thermal decomposition of CH_2Cl_2.** Lim, K.P.; Michael, J.V. Argonne National Lab., IL (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940711–15: 25. international symposium on combustion, Irvine, CA (United States), 31 Jul - 5 aug 1994). Order Number DE94013303. Source: OSTI; NTIS; GPO Dep.

The thermal decomposition of CH_2Cl_2 has been investigated in reflected shock waves experiments at temperatures between 1400–2300 K and at three different loading pressures with various initial CH_2Cl_2 concentrations. The resulting product Cl-atoms are monitored by the atomic resonance absorption spectrometer (ARAS) technique. A reaction mechanism is used to numerically simulate the measured Cl-atom profiles in order to obtain rate constants for the two primary dissociation reactions: (1) $CH_2Cl_2 \rightarrow CHCl + HCl$ and (2) $CH_2Cl_2 \rightarrow CH_2Cl + Cl$. The experimental second-order Arrhenius expressions for the two reactions are $k_1/[Kr] = 2.26 \times 10^{-8}$ exp(-29007 K/T) cm^3 $molecule^{-1}$ s^{-1} and $k_2/[Kr] = 6.64 \times 10^{-9}$ exp(-28404 K/T) cm^3 $molecule^{-1}$ s^{-1}, with standard deviations of ±43% and 40%, respectively. Results are compared to theoretical calculations using the semi-empirical Tore formalism. The best fits to the experimental data obtained with threshold energy and collisional energy transfer parameters of $E_{10}° = 73.0$ kcal $mole^{-1}$ and $\Delta E_{1down} = 630$ cm^{-1}. Similar values for reaction (2) are $E_{20}° = \Delta H_{20}° = 78.25$ kcal $mole^{-1}$ and $\delta E_{2down} = 394$ cm^{-1}.

22145 (ANL/CHM/CP–81410) **The thermal reactions of CH_3.** Lim, K.P.; Michael, J.V. Argonne National Lab., IL (United States). [1994]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940711–16: 25. international symposium on combustion, Irvine, CA (United States), 31 Jul - 5 aug 1994). Order Number DE94013395. Source: OSTI; NTIS; GPO Dep.

The thermal reactions of CH_3-radicals have been investigated in reflected shock waves experiments at temperatures between 1224–2520 K. The fast dissociation of CH_3I served as the source of CH_3. Experiments were performed at three loading pressures with variations in $[CH_3I]_0$. H-atoms formed in the reaction, $2CH_3 \rightarrow C_2H_5 + H$, were measured by the atomic resonance absorption spectrometric (ARAS) technique. The product ethyl radicals subsequently decompose to give a second H-atom and ethylene. A reaction mechanism was used to fit the data, and the resulting value for the rate constant was 5.25×10^{-11} exp(-7384 K/T) cm^3 $molecule^{-1}$ s^{-1}. This value is compared to earlier determinations. At higher temperatures, 2150–2520 K, the H-atom formation rate was dominated by CH_3 thermal dissociation. With simulations, the rate constant for $CH_3 + Kr \rightarrow CH_2 + H + Kr$ could be determined. The rate constant for this process is: $k = 4.68 \times 10^{-9}$ exp(-42506 K/T) cm^3 $molecule^{-1}$ s^{-1}. This result is compared to earlier experimental determinations and also to theoretical calculations using the semi-empirical Troe formalism.

22146 (ANL/CHM/PP–77421) **Correlation analysis of optical absorption cross section and rate coefficient measurements in reacting systems.** Hessler, J.P. (Argonne National Lab., IL (United States)); Ogren, P.J. Argonne National Lab., IL (United States). 31 Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013401. Source: OSTI; NTIS; GPO Dep.

A technique was developed for determining relative importance and correlation between reactions making up a complex kinetic system. This technique was used to investigate measurements of

optical absorption cross sections and the correlation between cross sections and measured rate coefficients. It is concluded that (1) species, initial conditions, and temporal regions may be identified where cross sections may be measured without interference from the kinetic behavior of the observed species and (2) experiments designed to measure rate coefficients will always be correlated with the absorption cross section of the observed species. This correlation may reduce the accuracy of rate coefficient measurements.

22147 (DOE/ER/14305–2) **[Bond selective chemistry beyond the adiabatic approximation]: Technical progress report, June 15, 1993–June 14, 1994.** Butler, L.J. Chicago Univ., IL (United States). 22 Feb 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14305. Order Number DE94012486. Source: OSTI; NTIS; GPO Dep.

Developing predictive ability for branching between energetically allowed chemical reaction pathways is important for design of efficient combustion processes and the development/utilization of new fuels. The work in the second year investigates the central role played by coupling between electronic states in polyatomic molecules in the selective branching between energetically allowed fragmentation pathways. Five projects are described: dynamics in Franck-Condon and exit channels regions of dissociating H_2S (emission spectra upon tunable excitation 199-203 nm); selective C-Br bond fission in 1,3-bromoiodopropane (intramolecular distance dependence of coupling between electronic configurations); testing adiabatic predictions for the C-S:S-H bond fission branching in CH_3SH; competition between bond fission channels and H_2 elimination in CH_3NH_2; and determination of absolute C-C: C-X (X=Br, Cl) branching ratios in bromoacetone and chloroacetone photolysis using acetyl chloride photodissociation.

22148 (DOE/ER/14306–2) **Infrared spectroscopy of organic free radicals related to combustion processes: [Annual] progress report, February 14, 1993–February 14, 1994.** Weisshaar, J.C. Wisconsin Univ., Madison, WI (United States). Dept. of Chemistry. [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14306. Order Number DE94012481. Source: OSTI; NTIS; GPO Dep.

Experiments were done to resolve internal rotor states in parent cations of aromatic molecules cooled in skimmed, pulsed nozzle expansion. Internal rotation of methyl and silyl groups attached to aromatic rings was studied. S_1-S_0 spectra were measured using one-color R2PI (resonant two-photon ionization). Ab initio calculations using the GAUSSIAN package were carried out. For various neutral and cationic ground states with threefold or sixfold barriers, effects of different levels of theory on calculated barrier height and phase were tested. The HF/6-31G* level of theory was used to calculate V_6 and V_3 for a variety of S_0 molecules. Distortions of the phenyl ring and precession of rotor axis as the methyl group rotates are discussed.

22149 (DOE/PC/92152–T7) **[The physics of coal liquid slurry atomization]: Annual report 1992.** Chigier, N.; Brown, W.J. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering. [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92152. Order Number DE94013069. Source: OSTI; NTIS; GPO Dep.

In order to understand the physics of atomization and to predict and improve the performance of atomizers, a survey on the effects of turbulence on atomization has been made. The influence of gas turbulence intensity on the disintegration of a liquid jet, while a constant mean velocity in both gas and liquid streams has been maintained, has been studied. A study has been made of the influence of changing dynamic surface tension on liquid surface wave characteristics and atomization. The dynamic surface tension of water was changed by adding Triton X-100 non-ionic surfactant into the liquid supplied to a two dimensional slot atomizer. Wave frequencies were measured using laser beam attenuation. Dynamic surface tension changes were found to influence liquid sheet disintegration with little effect on wave frequencies. A series of experiments have been conducted to determine the fundamental processes of injection and atomization of liquid propellants for rocket combustion chambers because of their direct influence on combustion instability. For coaxial injectors, liquid and gas flow rates have been progressively changed. Microphotography was used to obtain details of wave disturbances on liquid surfaces. Direct measurements were made of wavelength and frequency of wave propagation on liquid surfaces. Frequency was found to remain constant along the length of the liquid surface. Pulsations in the liquid jet caused drops to form clusters with the same frequency as that of jet surface waves. Measured frequencies were in the range of those measured in combustion instability experiments. Detailed measurements have been made in the sprays using the phase Doppler particle analyzer. Measurements of drop size, velocity and number density are related to the disintegration process. Increasing turbulence intensity in the gas stream is a very effective means of reducing drop size, increasing spray width, and therefore, improving combustion.

22150 (SAND–94-8500C) **Relationships among nitric oxide, temperature and mixture fraction in hydrogen jet flames.** Barlow, R.S. (Sandia National Labs., Livermore, CA (United States)); Carter, C.D. Sandia National Labs., Livermore, CA (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-940838–2: 25. combustion symposium, Irvine, CA (United States), 1 Aug 1994). Order Number DE94005106. Source: OSTI; NTIS; GPO Dep.

Simultaneous point measurements of NO, the major species, mixture fraction, temperature, and OH are obtained in nonpremixed turbulent hydrogen jet flames, using the combination of spontaneous Raman scattering, Rayleigh scattering, and laser-induced fluorescence. Results are presented for an undiluted hydrogen flame at Reynolds number 10,000 and for flames with 20% and 40% helium dilution. Radial dependence of conditional mean NO mole fraction (conditional on mixture fraction) is shown to be small at upstream locations and negligible at the downstream locations that contribute most to the overall NO emission. Near the flame base, where NO formation rates and concentrations are sensitive to local strain, fluctuations of the NO mole fraction conditional on mixture fraction are 40 to 50% of conditional mean. When average NO levels are calculated conditional on both mixture fraction and temperature, a significant temperature dependence is found. However, this double conditioning does not substantially reduce NO fluctuations relative to the mean values. These results combined with previously reported data on the present hydrogen flames provide a detailed basis for evaluation and refinement of turbulent combustion models for thermal NO_x formation in jet flames.

22151 (SAND–94-8501C) **Influences of flame-vortex interactions on formation of oxides of nitrogen in curved methane-air diffusion flamelets.** Card, J.M. (Sandia National Labs., Livermore, CA (United States)); Ryden, R.; Williams, F.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-940838–4: 25. combustion symposium, Irvine, CA (United States), 1 Aug 1994). Order Number DE94005105. Source: OSTI; NTIS; GPO Dep.

To improve knowledge of production rates of nitrogen oxides in turbulent diffusion flames in reaction-sheet regimes, an analytical investigation is made of the structure of a parabolic flamelet. The mixture-fraction field, scalar dissipation rate and gas velocity relative to the flamelet in the vortex are related to flame curvature at the parabolic tip. Flame structure for major species and temperature is described by rate-ratio asymptotics based on two-step and three-step reduced chemical-kinetic mechanisms. Production rates by prompt, thermal and nitrous-oxide mechanisms are obtained from one-step reduced-chemistry approximations that employ steady states for all reaction intermediaries. For sufficiently large streamwise separation distances between isoscalar surfaces, it is found that equilibrium conditions are closely approached near the flame tip, and the thermal mechanism dominates there, but the prompt mechanism always dominates in the wings, away from the tip, where the highest rates of scalar dissipation occur. Increasing the tip curvature increases the Peclet number and the prompt contribution while decreasing the thermal contribution. At 1 atm and ambient temperatures of 300 K, the prompt mechanism always dominates the total production rate in the parabolic flamelet, and, perhaps surprisingly, the rate of the nitrous-oxide mechanism is faster than that of the thermal mechanism and varies with the tip curvature and with scalar dissipation in the same manner as that of

the prompt mechanism, different from that of the thermal mechanism. Conclusion reached is that Zel'dovich NO is relatively insignificant in hydrocarbon-air mixtures in reaction-sheet regimes.

22152 (SAND–94-8502C) **Laser Raman scattering measurements of differential molecular diffusion in turbulent nonpremixed jet flames of H_2/CO_2 fuel.** Smith, L.L. (California Univ., Berkeley, CA (United States). Dept. of Mechanical Engineering); Dibble, R.W.; Talbot, L.; Barlow, R.S.; Carter, C.D. Sandia National Labs., Livermore, CA (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-940838–3: 25. combustion symposium, Irvine, CA (United States), 1 Aug 1994). Order Number DE94005108. Source: OSTI; NTIS; GPO Dep.

This paper explores effects of differential diffusion in nonpremixed turbulent jet flames. Pulsed Raman scattering spectroscopy is used to measure temperature and species concentrations in chemically reacting jets of H_2/CO_2 into air, over a range of jet Reynolds numbers from 1,000 to 30,000 based on cold jet fluid properties. Results show significant effects of differential diffusion at all jet Reynolds numbers considered. Differential diffusion between H_2 and $C0_2$ produces differences between the hydrogen element mixture fraction (ξ_H) and the carbon element mixture fraction (ξ_c). The greatest effects occur on the rich side of stoichiometric, where ξ_H is observed to be smaller than ξ_C at all Reynolds numbers. Differential diffusion between H_2 and H_2O creates a net flux of hydrogen element toward the stoichiometric contour and causes a local maximum in ξH that occurs near the stoichiometric condition. A differential diffusion variable ^ZH is defined as the difference between ξ_H and ξ_C. The variance Of ^ZH conditional on ξ_C also shows that differential diffusion effects are greatest on the rich side of the flame. Conditional variances of ^ZH are largest at intermediate Reynolds numbers.

22153 (SAND–94-8507C) **Finite-rate chemistry and transient effects in Direct Numerical Simulations of turbulent non-premixed flames.** Mahalingam, S. (Colorado Univ., Boulder, CO (United States). Dept. of Mechanical Engineering); Chen, J.H.; Vervisch, L. Sandia National Labs., Albuquerque, NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-940838–5: 25. combustion symposium, Irvine, CA (United States), 1 Aug 1994). Order Number DE94005250. Source: OSTI; NTIS; GPO Dep.

Three-dimensional Direct Numerical Simulations (DNS) of turbulent non-premixed flames including finite-rate chemistry and heat release effects were performed. Two chemical reaction models were considered: (1) a single-step global reaction model in which the heat release and activation energy parameters are chosen to model methane-air combustion, and (2) a two-step reaction model to simulate radical production and consumption and to compare against the single-step model. The model problem consists of the interaction between an initially unstrained laminar diffusion flame and a three-dimensional field of homogeneous turbulence. Conditions ranging from fast chemistry to the pure mixing limit were studied by varying a global Damkoehler number. Results suggest that turbulence-induced mixing acting along the stoichiometric line leads to a strong modification of the inner structure of the turbulent flame compared with a laminar strained flame, resulting in intermediate species concentrations well above the laminar prediction. This result is consistent with experimental observations. Comparison of the response of the turbulent flame structure due to changes in the scalar dissipation rate with a steady strained laminar flame reveals that unsteady strain rates experienced by the turbulent flame may be responsible for the observed high concentrations of reaction intermediates.

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Refer also to citation(s) 21690

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Refer also to citation(s) 20803, 20804, 20807, 20810, 20825, 20863, 20864, 20865, 20866, 20875, 20876, 20917, 20984, 21009, 21036, 21045, 21046, 21069, 21109, 21358, 21593, 21865, 21956, 22030, 22034, 22051, 22106, 22370, 22439, 22441, 22460, 22530, 22781, 23208, 23274, 23285, 23309, 23331

22154 (ANL/RE/CP–82468) **Identification of factors that influence the stiffness of high-damping elastomer seismic isolation bearings.** Kulak, R.F.; Hughes, T.H. Argonne National Lab., IL (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–17: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012514. Source: OSTI; NTIS; INIS; GPO Dep.

During the past decade, high-damping elastomer, steel-laminated seismic isolation bearings have gained acceptance as a device for isolating large buildings and structures from earthquake damage. In the United States, architectural engineering firms custom design isolators for each project and ten have the isolators manufactured by one of less than a hand-full of manufactures. The stiffness of the bearing is the single most important design parameter that the molded bearing must meet because it determines the fundamental frequency of the isolation system. This paper reports on recent research that examined several factors that cause real and potential variations to the stiffness of the bearing. The resulting changes to the fundamental frequency of the isolated structure are quantified for each factor. The following were examined: (1) dimensional tolerances, (2) frequency effects, (3) temperature effects, (4) cyclical effects, and (5) aging effects. It was found that geometric variations barely affect the stiffness whereas temperature variations greatly affect the stiffness.

22155 (ANL/RE/CP–82548) **Seismic responses of an unanchored generic fixture with different simulated boundary conditions.** Wu, Ting-shu; Blomquist, C.A.; Herceg, J.E. Argonne National Lab., IL (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–15: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012450. Source: OSTI; NTIS; GPO Dep.

In the design of equipment for seismic loadings, it is common to anchor the equipment to prevent tipping or sliding. However, there are situations where the equipment should not be anchored. An unanchored piece of equipment is held to the floor only by the gravitational effect and, in the absence of friction, it could move freely. In the analytical investigation of an unanchored item during a seismic event, there is uncertainty on the proper simulation of the boundary conditions so that the analysis model will have no rigid body motion. Seismic responses of a simple analytical model that is representative of a group of unanchored equipment have been investigated with different sets of simulated boundary conditions. The results show when the main interest of investigation is to the potential for tipping during an earthquake, the case with one of the four supporting pads simply supported, its two neighboring pads constrained against twisting motion, and all pads without vertical displacements yields the most conservative prediction.

22156 (CONF-9009342–1) **Mean flow development of a longitudinal vortex embedded in an attached, three-dimensional, turbulent boundary layer.** Shizawa, T. (Science Univ. of Tokyo (Japan)); Eaton, J.K. Stanford Univ., CA (United States). Dept. of Mechanical Engineering. [1990]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER13608. From International symposium on engineering turbulence modelling and measurements; Dubrovnik (Yugoslavia); 24-28 Sep 1990. Order Number DE94013596. Source: OSTI; NTIS; GPO Dep.

The interaction of a longitudinal vortex with a pressure-driven, three dimensional turbulent boundary layer was investigated experimentally. The vortex was attenuated much more rapidly in the three dimensional layer than in a two-dimensional boundary layer. The persistence for the vortex-induced perturbation was strongly dependent on the sign of the vortex.

22157 (CONF-940449–9) **Automatic calibration of laser range cameras using arbitrary planar surfaces.** Baker, J.E. Oak Ridge National Lab., TN (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From Society of Photo-Optical Instrumentation Engineers conference on intelligent information systems; Orlando, FL (United States); 4-8 Apr 1994. Order Number DE94012325. Source: OSTI; NTIS; GPO Dep.

Laser Range Cameras (LRCs) are powerful tools for many robotic/computer perception activities. They can provide accurate range images and perfectly registered reflectance images of the target scene, useful for constructing reliably detailed 3-D world maps and target characterizations. An LRC's output is an array of distances obtained by scanning a laser over the scene. To accurately interpret this data, the angular definition of each pixel, i.e., the 3-D direction corresponding to each distance measurement, must be known. This angular definition is a function of the camera's intrinsic design and unique implementation characteristics, e.g., actual mirror positions, axes of rotation, angular velocities, etc. Typically, the range data is converted to Cartesian coordinates by calibration-parameterized, non-linear transformation equations. Unfortunately, typical LRC calibration techniques are manual, intensive, and inaccurate. Common techniques involve imaging carefully orchestrated artificial targets and manually measuring actual distances and relative angles to infer the correct calibration parameter values. This paper presents an automated method which uses Genetic Algorithms to search for calibration parameter values and possible transformation equations which combine to maximize the planarity of user-specified sub-regions of the image(s). This method permits calibration to be based on an arbitrary plane, without precise knowledge of the LRC's mechanical precision, intrinsic design, or its relative positioning to the target. Furthermore, this method permits rapid, remote, and on-line recalibration - important capabilities for many robotic systems. Empirical validation of this system has been performed using two different LRC systems and has led to significant improvement in image accuracy while reducing the calibration time by orders of magnitude.

22158 (CONF-9404137–2) **Omnidirectional holonomic platforms.** Pin, F.G.; Killough, S.M. Oak Ridge National Lab., TN (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. symposium on energy engineering sciences; Argonne, IL (United States); 27-29 Apr 1994. Order Number DE94013252. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the concepts for a new family of wheeled platforms which feature full omnidirectionality with simultaneous and independently controlled rotational and translational motion capabilities. The authors first present the orthogonal-wheels concept and the two major wheel assemblies on which these platforms are based. They then describe how a combination of these assemblies with appropriate control can be used to generate an omnidirectional capability for mobile robot platforms. The design and control of two prototype platforms are then presented and their respective characteristics with respect to rotational and translational motion control are discussed.

22159 (CONF-940613–24) **Simplified design and evaluation of liquid storage tanks relative to earthquake loading.** Poole, A.B. Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Pressure vessel and piping conference; Minneapolis, MN (United States); 19-23 Jun 1994. Order Number DE94013264. Source: OSTI; NTIS; GPO Dep.

A summary of earthquake-induced damage in liquid storage tanks is provided. The general analysis steps for dynamic response of fluid-filled tanks subject to horizontal ground excitation are discussed. This work will provide major attention to the understanding of observed tank-failure modes. These modes are quite diverse in nature, but many of the commonly appearing patterns are believed to be shell buckling. A generalized and simple-to-apply shell loading will be developed using Fluegge shell theory. The input to this simplified analysis will be horizontal ground acceleration and tank shell form parameters. A dimensionless parameter will be developed and used in predictions of buckling resulting from earthquake-imposed loads. This prediction method will be applied to various tank designs that have failed during major earthquakes and during shaker table tests. Tanks that have not failed will also be reviewe A simplified approach will be discussed for early design and evaluation of tank shell parameters and materials to provide a high confidence of low probability of failure during earthquakes.

22160 (CONF-940859–16-Pt.2) **A new technique for dynamic load distribution when two manipulators mutually lift a rigid object: Part 2, Derivation of entire system model and control architecture.** Unseren, M.A. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. international symposium on robotics and manufacturing; Maui, HI (United States); 14-18 Aug 1994. Order Number DE94010126. Source: OSTI; NTIS; GPO Dep.

A rigid body model for the entire system which accounts for the load distribution scheme proposed in Part 1 as well as for the dynamics of the manipulators and the kinematic constraints is derived in the joint space. A technique is presented for expressing the object dynamics in terms of the joint variables of both manipulators which leads to a positive definite and symmetric inertia matrix. The model is then transformed to obtain reduced order equations of motion and a separate set of equations which govern the behavior of the internal contact forces. The control architecture is applied to the model which results in the explicit decoupling of the position and internal contact force-controlled degrees of freedom (DOF).

22161 (CONF-940859–17-Pt.1) **A new technique for dynamic load distribution when two manipulators mutually lift a rigid object: Part 1, The proposed technique.** Unseren, M.A. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. international symposium on robotics and manufacturing; Maui, HI (United States); 14-18 Aug 1994. Order Number DE94010124. Source: OSTI; NTIS; GPO Dep.

A general framework for solving the dynamic load distribution when two manipulators hold a rigid object is proposed. The underspecified problem of solving for the contact forces and torques based on the object's equations of motion is transformed into a well specified problem. This is accomplished by augmenting the object's equations of motion with additional equations which relate a new vector variable quantifying the internal contact force and torque degrees of freedom (DOF) as a linear function of the contact forces and torques. The resulting augmented system yields a well specified solution for the contact forces and torques in which they are separated into their motion inducing and internal components. A particular solution is suggested which enables the designer to conveniently specify what portion of the payload's mass each manipulator is to bear. It is also shown that the results of the previous work are just a special case of the general load distribution framework described here.

22162 (DOE/MC/29104–3662) **Mobile workstation for decontamination and decommissioning operations.** Whittaker, W.L. (Carnegie-Mellon Univ., Pittsburgh, PA (United States). Robotics Inst.); Osborn, J.F.; Thompson, B.R. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Robotics Inst.; Redzone Robotics, Inc., Pittsburgh, PA (United States). Oct 1993. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-92MC29104. Order Number DE94004079. Source: OSTI; NTIS; INIS; GPO Dep.

This project is an interdisciplinary effort to develop effective mobile worksystems for decontamination and decommissioning (D&D) of facilities within the DOE Nuclear Weapons Complex. These mobile worksystems will be configured to operate within the environmental and logistical constraints of such facilities and to perform a number of work tasks. Our program is designed to produce a mobile worksystem with capabilities and features that are matched to the particular needs of D&D work by evolving the design through a series of technological developments, performance tests and evaluations. The project has three phases. In this the first phase, an existing teleoperated worksystem, the Remote Work Vehicle (developed for use in the Three Mile Island Unit 2 Reactor Building basement), was enhanced for telerobotic performance of several

D&D operations. Its ability to perform these operations was then assessed through a series of tests in a mockup facility that contained generic structures and equipment similar to those that D&D work machines will encounter in DOE facilities. Building upon the knowledge gained through those tests and evaluations, a next generation mobile worksystem, the RWV II, and a more advanced controller will be designed, integrated and tested in the second phase, which is scheduled for completion in January 1995. The third phase of the project will involve testing of the RWV II in the real DOE facility.

22163 (DOE/NE/37969–5) **Semi-autonomous robots for reactor containments: Annual summary report, [1993–1994].** Michigan Univ., Ann Arbor, MI (United States). 6 May 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86NE37969. Order Number DE94012485. Source: OSTI; NTIS; INIS; GPO Dep.

During 1993, the activity at the University was split into two primary groups. One group provided direct support for the development and testing of the RVIR vehicle. This effort culminated in a demonstration of the vehicle at ORNL during December. The second group of researchers focused attention on pushing the technology forward in the areas of radiation imaging, navigation, and sensing modalities. A major effort in technology transfer took place during this year. All of these efforts reflected in the periodic progress reports which are attached. During 1994, our attention will change from the Nuclear Energy program to the Environmental Restoration and Waste Management office. The immediate needs of the Robotics Technology Development Program within the Office of Technology Development of EM drove this change in target applications. The University will be working closely with the national laboratories to further develop and transfer existing technologies to mobile platforms which are currently being designed and employed in seriously hazardous environments.

22164 (DOE/RL–93-30) **Performance-oriented packagings for hazardous materials: Resource guide.** USDOE Richland Operations Office, WA (United States). Sep 1993. 679p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013574. Source: OSTI; NTIS; INIS; OSTI; NTIS; INIS; GPO Dep.

This document provides recommendations to US Department of Energy (DOE) shippers regarding packaging that meet performance-oriented packaging requirements implemented by US Department of Transportation (DOT) in rulemaking HM-181 (December 21, 1990) and subsequent actions. The packaging described in this document are certified by their vendor to comply with requirements for Packing Group I, II, or III hazardous materials packaging. The intent of this document is to share information between DOE and contractors and at all DOE facilities.

22165 (ENEA-RT-AMB–93-08) **Laser beam machining fume hoods and sampling and analysis equipment: Test facility design specifications.** Picini, P. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Galuppi, G.; Carcipreso, G.; Lombardi, C. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Oct 1993. 56p. (In Italian). (RT/AMB–93-08). Order Number DE94775315. Source: OSTI; NTIS (US Sales Only).

The kind and quantity of fumes arising from high temperature processes depend on several parameters and their combination. Materials, surface impurities, thickness, laser type, laser machine parameters, laser power, processing velocities, gas shielding and flow rate are only some of the parameters that strongly influence the type and quantity of fume emissions. Moreover, fume extraction plant layout, flow rate and, emission sampling and analysis methods can affect the measurement results. Individual Italian governmental organizations (ENEA - Italian Agency for Energy, New Technologies and the Environment - AMB and ENEA INN) and private industries (FIAT CRF, RTM and CISE) will carry out measurements to characterize fumes and each shall have its own system of fumes generation, extraction, sampling and analysis; it is therefore necessary that the experimental facilities are as similar as possible in order to obtain sufficiently comparable results The general aim of the work presented here is to define the main design specifications of the experimental facility and, according to Italian standards, the fumes sampling and analysis methods.

22166 (ENEA-RT-AMB–93-10) **Hot wire anemometer calibration by laser Doppler anemometry.** Antonini, A. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Picini, P.; Sbrana, M.; Ricotta, A.; Giammartini, S.; Manfredi, F. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Oct 1993. 74p. (In Italian). (RT/AMB–92-10). Order Number DE94775308. Source: OSTI; NTIS (US Sales Only).

Within the framework of a project aimed at developing an aerosol isokinetics sampling system to be used in ducted flows, a numerical model for the aerosols sampling was set up. To verify the sampling system modeling, an experimental program of velocity and particle distribution measurements was planned. To determine the velocity profiles, DANTEC hot wire measuring systems were selected and, in order to guarantee precise and accurate measurements, a calibration program was performed by the laser Doppler technique. The laser Doppler technique is a non-interfering absolute calibration method, independent on motion regimes and with a wide velocity measuring range. The goal of the work was twofold: calibration of the hot wire sensors and the investigation of their behaviour in real experimental conditions.

22167 (ENEA-RT-INN–93-20) **Landmark recognition using a two stage neural architecture (Italian ENEA robotics development).** Taraglio, S. (ENEA, Casaccia (Italy). Area Energia e Innovazione); Bufacchi, A. ENEA, Casaccia (Italy). Area Energia e Innovazione. Nov 1993. 8p. (RT/INN–93-20). Order Number DE94775312. Source: OSTI; NTIS (US Sales Only).

ENEA (Italian Agency for Energy, New Technologies and the Environment) is currently developing a project in robotics in order to design an autonomous mobile robot able to navigate in an indoor environment. Its name is ROBERT, i.e., ROBot with Environment Recognition Tools. The project is intended to be a testing workbench for artificial vision in all its approaches: algorithmical, symbolic and neural. In fact, this robot is supposed to compute its position in the environment through the use of a vision system able to recognize some major landmarks. This paper presents a two stage neural network architecture to implement a visual system for a robotic application. The first stage of it is devoted to the data compression and feature extraction on the input image, while the second performs the actual recognition of some given landmarks.

22168 (HW–75222) **Critical mass control: Continuous neptunium.** Barnes, R.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 May 1962. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94010649. Source: OSTI; NTIS; GPO Dep.

Declassified.

During April 1962, equipment in both the main Redox Building (202-S) and the Plutonium Concentration Building (233-S) vas rearranged to allow the accumulation and recovery of neptunium without interference with the production of uranium and plutonium. In order to do this, the former rework column (1S) was put into continuous service as a neptunium recovery column, the Third Plutonium Cycle was converted to a neptunium decontamination cycle, and ion-exchange equipment was installed in the 233-S Building to replace the Third Plutonium Cycle. The neptunium, once decontaminated, will be concentrated and loaded out via its own system in the 233-S Building. To check the critical mass safety of the new arrangement, a formal hazards review was made, the results of which are reported in this document.

22169 (INIS-JP–018, pp. 847-859) **2D modelling of a UF6 container in a fire.** Duret, B. (CEA Centre d'Etudes de Grenoble, 38 (France). Direction des Reacteurs Nucleaires); Seiler, J.M. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

We present some results on 2D thermal modelisation of the behaviour of UF6 in a fire. A cylindrical container is engulfed by a high temperature space where the heat transfer is expected to occur by radiation only. During the first minutes, we assume that the

thermal resistance is between the external wall and the UF6 solid, the heat transfer can be split up into three kinds: (1) conduction to solid UF6 through a contact surface. (2) radiative transfer. (3) gas layer with a small heat conductance. This thermal resistance is initially determined by the UF6 filling type, shape and also is time dependant by thermal dilatation effects. On the onset of liquifying the heat transfer increases because of the larger liquid exchange. The liquid and boiling heat flow is then calculated by a model on the basis of classical correlations in vertical cavities. Numerical evaluations have been performed with a finite element model using: ANSYS. With a realistic hypothesis, the effect of the following parameters is estimated: thermal conductivity of UF6 solid, contact surface fraction, UF6 emissivity, gas gap thickness, liquid UF6 wall exchange, solid liquid transition criteria, non condensation factor k. (J.P.N.).

22170 (INIS-JP–018, pp. 860-867) **The development of thermal models for a UF6 transport container in a fully engulfing fire.** Lomas, J. (British Nuclear Fuels plc, Risley (United Kingdom)); Clayton, D.G. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

This paper describes the recent development work on a lumped-parameter model known as BURST3 created by BNFL to examine the physics of the heating problem. The predictions of this model were compared with the results obtained by Mallett in 1965, in which small (3.5, 5 and 8 inch diameter) cylinders were exposed to a fire. In general, the comparison is good; however there are some differences - particularly on the speed of response of the wall temperature to the heating from the fire. The model was further modified to allow conditions of partial and full insulation to be investigated. The partially insulated condition simulates the Japanese proposal to insulate the ends of the container only, leaving the cylinder bare between the stiffening rings. The results obtained with our modified model support the predictions of Abe et al that the partially-insulated cylinder will survive the fire test. The analysis of a completely insulated container has indicated that a minimal thickness of insulation provides sufficient protection to allow survival in the fire test. A discussion of additional improvements to the lumped-parameter model are presented. (J.P.N.).

22171 (INIS-JP–018, pp. 868-876) **TENERIFE program: high temperature experiments on A 4 tons UF_6 container.** Casselman, C. (CEA Centre d'Etudes de Grenoble, 38 (France)); Duret, B.; Seiler, J.M.; Ringot, C.; Warniez, P.; Wataru, M.; Shiomi, S.; Ozaki, S.; Yamakawa, H. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

To know the input of the future thermo-mechanical code, we have to get a better understanding of the thermo-physical evolution of the UF_6 which pressurizes the container. This evolution is function of: (a) the heat transfer rate from the fire to the container (b) the UF_6 behaviour in the container. These tests are essentially analytical at simulated fire temperatures of between 800 and 1000degC. They use a representative mass of UF_6 (around 4 tons). The tests will not seek to rupture the test container which has a diameter equal to the 48Y container, but shorter length. These tests carried out in realistic conditions (typical thermal gradient at the wall, characteristic period for UF_6 internal mass transfer) should make possible to improve knowledge of two fundamental phenomena: (1) vaporization of UF_6 on contact with the heated wall (around 400degC), a phenomenon which controls the container internal pressurization kinetic, (2) the equivalent conductivity of solid UF_6, a phenomenon which is linked to the heat transfer by UF_6 vaporization-condensation through the solid's porosities and which depends on the diameter of the container. In addition, they will allow the influence of other parameters to be studied, such as UF_6 container filling mode or the mechanical characteristics of the container material. A UF_6 container fitted with instruments (wall temperature, UF_6 temperature, pressure) is heated by a rapid heat transient in a radiating furnace where the temperature and thermal power supplied can be measured. The test continues until pre-established thresholds have been reached: (1) strain threshold measured on the container surface (strain gauges positioned on the outside), (2) maximum temperature threshold of UF_6, (3) container internal pressure threshold. (J.P.N.).

22172 (INIS-mf–13778) **International conference on control theory and its applications: Scientific programme and abstracts.** Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Various presentations on robotics and control theory and computer codes are included.

22173 (INIS-mf–13778, pp. 2-3) **An observer-based controller and related topics in robot control.** Ailon, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. REMOTE CONTROL/servomechanisms; CONTROL THEORY; FLEXIBILITY; JOINTS; SERVOMECHANISMS; SPRINGS

22174 (INIS-mf–13778, pp. 7-8) **Adaptive min-max controller for robot arms subjected to time-varying model uncertainties.** Attal, M. (Technion-Israel Inst. of Tech., Haifa (Israel)); Gil, A.; Gutman, S.; Shoham, M. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. MANIPULATORS/control theory; DIFFERENTIAL EQUATIONS; MANIPULATORS; MATERIALS HANDLING; ROBOTS; TIME DEPENDENCE

22175 (INIS-mf–13778, pp. 12-13) **Feedback stabilization of periodic solutions.** Bacciotti, A. (Politecnico di Torino, Turin (Italy)). Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CONTROL THEORY/feedback; FEEDBACK; DIFFERENTIAL EQUATIONS; VARIATIONS

22176 (INIS-mf–13778, pp. 14) **The servo problem in systems affected by nonlinear friction.** Baril, C.G. (Technion-Israel Inst. of Tech., Haifa (Israel)); Gutman, Per O. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CONTROL THEORY/servomechanisms; SERVOMECHANISMS; FRICTION

22177 (INIS-mf–13778, pp. 17-19) **Auto tune procedure for electromechanical systems.** Barlev, N. (Servotech Control Technologies, Rishon-le-Zion (Israel)); Cohen, I. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications:*

Scientific programme and abstracts. Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CONTROL EQUIPMENT/ electromechanics; ELECTROMECHANICS; KNOWLEDGE BASE; OPTIMIZATION; REMOTE HANDLING EQUIPMENT

22178 (INIS-mf–13778, pp. 37-38) **Robomatix Laser Controller - 1: A robot motion and laser power controller.** Cohen, I. (Robomatix Ltd., Raanana (Israel)); Yalov, S. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ON-LINE CONTROL SYSTEMS/laser beam machining; AUTOMATION; DEGREES OF FREEDOM; FLEXIBILITY; LASERS; SERVOMECHANISMS

22179 (INIS-mf–13778, pp. 109-110) **Robotic control of dynamic tasks.** Rogozin, V. (Weizmann Inst. of Science, Rehovoth (Israel)); Flash, T.; Edan, Y. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ROBOTS/dynamic programming; REMOTE HANDLING EQUIPMENT; ROBOTS

22180 (JAERI-M–93-253) **Control method for biped locomotion robots based on ZMP information.** Kume, Etsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 87p. (In Japanese). Order Number DE94770823. Source: OSTI; NTIS; INIS.

The Human Acts Simulation Program (HASP) started as a ten year program of Computing and Information Systems Center (CISC) at Japan Atomic Energy Research Institute (JAERI) in 1987. A mechanical design study of biped locomotion robots for patrol and inspection in nuclear facilities is being performed as an item of the research scope. One of the goals of our research is to design a biped locomotion robot for practical use in nuclear facilities. So far, we have been studying for several dynamic walking patterns. In conventional control methods for biped locomotion robots, the program control is used based on preset walking patterns, so it dose not have the robustness such as a dynamic change of walking pattern. Therefore, a real-time control method based on dynamic information of the robot states is necessary for the high performance of walking. In this study a new control method based on Zero Moment Point (ZMP) information is proposed as one of real-time control methods. The proposed method is discussed and validated based on the numerical simulation. (author).

22181 (JAERI-M–94-051) **A study on intelligent nuclear systems: HASP: Human Acts Simulation Program progress report 1992.** Akimoto, Masayuki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Higuchi, Kenji; Fujii, Minoru; Kume, Etsuo; Kambayashi, Shaw; Ebihara, Ken-ichi; Otani, Takayuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 117p. (In Japanese). Order Number DE94770643. Source: OSTI; NTIS; INIS.

The sixth year progress of the Human Acts Simulation Program, HASP in short, has been presented in this report. The HASP started in 1987 at JAERI as ten-year research and development program of underlying technologies for intelligent robots, intelligent nuclear plants and so on. It consists of the research and development of technologies of knowledge-base, robot vision, robot kinematics/kinetics, plant geometry data-base, dose evaluation and high speed Monte Carlo machine. (author).

22182 (LA-UR–94-586) **Open architecture controllers for advanced manufacturing.** Gore, R.A. Los Alamos National Lab., NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940859–5: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94007572. Source: OSTI; NTIS; GPO Dep.

The application of intelligent control systems to the real world of machining and manufacturing will benefit form the presence of open architecture control systems on the machines or the processes. The ability to modify the control system as the process or product changes can be essential to the success of the application of neural net or fuzzy logic controllers. The effort at Los Alamos to obtain a commercially available open architecture machine tool controller is described.

22183 (LA-UR–94-930) **Robotic automation of the environmental chemical laboratory.** Hollen, R.M.; Erkkila, T.H. Los Alamos National Lab., NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940859–15: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94009361. Source: OSTI; NTIS; GPO Dep.

To date, automation of the environmental chemical laboratory has been a slow and tedious affair. In many, of our domestic analytical laboratories, automation consists of no more than analytical instrumentation coupled to an autosampling device. When we look into the future environmental needs of our nation, and indeed the world, it is apparent that we will not be able to keep up with the drastically increasing sample load without automated analyses. Stricter regulatory requirements on the horizon will potentially mandate staggering changes in sampling and characterization requirements. The Contaminant Analysis Automation (CAA) Program was initiated in 1990 by the US government's Department of Energy (DOE) to address these issues. By application of a new robotics paradigm, based on an integrated production chemistry foundation applied to analytical chemistry, the CAA will use standardized modular instruments called Standard Laboratory Modules (SLM) to provide flexible and standardized automation systems. By promoting the commercialization of this technology, CAA will provide the integrated robotics systems necessary to meet the coming remediation demands. This multilaboratory program is within the Robotics Technology Development Program (RTDP) of the Office of Technology Development (OTD).

22184 (LA-UR–94-1627) **Proposal for experiments with actinide elements.** Sanchez, R.G. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9405144–3: Nuclear criticality technology safety project workshop, Williamsburg, VA (United States), 10-11 May 1994). Order Number DE94012892. Source: OSTI; NTIS; INIS; GPO Dep.

An analytical study was conducted in which critical masses for some actinide isotopes were calculated with the Monte Carlo Neutron Photon (MCNP) Transport computer code. Different spherical computer models were used for even- and odd-neutron nuclides. Critical masses obtained are tabulated for Np-237, Pu-242, Am-241, Am-243, Pu-241, and Am-242m, together with indirect experimental data. Experimental data are needed for actinides with odd number of neutrons.

22185 (LBST–11/92, pp. 470.1-470.5) **Reactor design and catalyst deactivation for dehydrogenation reactors.** Ludwig-Boelkow-Systemtechnik (LBST), Ottobrunn (Germany); CONOC Continental Contactors GmbH, Hamburg (Germany). Jun 1992. Sponsored by Commission of the European Communities, Ispra (Italy). Joint Research Centre. Contract CEC-JRC 3723-89-05 PC ISP D/ Amendment No. 1. In *Euro-Quebec Hydro-Hydrogen Pilot Project (EQHHPP). Supplementary task programme: Final report.* 282p. Order Number DE94773925. Source: OSTI; NTIS (US Sales Only).

The purpose of this report is to improve the dehydrogenation efficiency from 90% to 99% toluene yields with a subsequent reduction of undesirable byproducts from 5-10% to less than 1%. By increasing catalyst activity and selectivity, the process economics of the liquid organic hydride system would be improved and hydrocarbon resources conserved. (orig.)

22186 (ORNL/ENG–12) **Furnace characterization for horizontal shipping container thermal testing.** Feldman, M.R. Oak Ridge National Lab., TN (United States). May 1994. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013051. Source: OSTI; NTIS; INIS; GPO Dep.

In order to perform regulatory thermal tests required by 10 CFR 71.73(c)(3) on the newly designed Horizontal Shipping Container (HSC), it was necessary to find a company involved in the business of heat treating who was willing to allow their furnace to be used for these tests. Of the companies responding to a request for interest, Lindberg Heat Treating Company's Solon, Ohio, facility was found to be the best available vendor for this activity. Their furnace was instrumented and characterized such that these tests could be performed in a manner that would conform to the specifications contained in 10 CFR 71. It was found that Lindberg's furnace was usable for this task, and recommendations concerning the use of this furnace for the above stated purpose are made herein.

22187 (ORNL/FTR–4914) **Criticality safety provisions for Safe Transport of Radioactive Material: Foreign trip report, February 12–18, 1994.** Parks, C.V. Oak Ridge National Lab., TN (United States). 4 Mar 1994. 38p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94008238. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses travel to participate in a Consultant Services Meeting (CSM) on Criticality Safety Provisions for the International Atomic Energy Agency Regulations on Safe Transport of Radioactive Material. The need for a Consultant Services Meeting on criticality safety was identified at the Second Technical Committee Meeting on the Revision of the IAEA Regulations for the Safe Transport of Radioactive Material held May 17–21, 1993. The major issues identified for the CSM agenda were reflection conditions for the individual package in isolation, use of irradiation history in criticality safety assessments, development of additional advisory and explanatory material for the IAEA Regulations, and review and consideration of a discussion paper on safety issues prepared by D. Mennerdahl of Sweden. Other issues for CSM discussion and consensus advice were raised by the Secretariat and various CSM members. The CSM report will be forwarded to the Third Technical Committee Meeting on the Revision of the Regulations for their consideration.

22188 (PNL–9440) **Examination of furnace belt failure in 232-Z incinerator.** Nelson, T.C. Battelle Pacific Northwest Lab., Richland, WA (United States). 11 Feb 1965. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012048. Source: OSTI; NTIS; GPO Dep.

Metallographic examination has been completed on samples from the Nichrome V wire mesh furnace belt in the 232-Z building incinerator. During service the furnace belt had broken in several places where the wire was welded together. A grain boundary phase was found in weld metal during metallographic examination of the as received material. It is probable to conclude that the failure during service was caused by accelerated corrosion of the weld and that the accelerated corrosion in that area was related to the structure of the weld metal. It would be informative to examine welds from the furnace belts that have not failed to further study the cause for the failure.

22189 (SAND–93-1320) **Modeling of the second stage of the STAR 1.125 inch two-stage gas gun.** Longcope, D.B. Jr. Sandia National Labs., Albuquerque, NM (United States). May 1993. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012138. Source: OSTI; NTIS; GPO Dep.

The second stage of the Shock Technology and Applied Research (STAR) facility two-stage light gas gun at Sandia National Laboratories has been modeled to better assess its safety during operation and to determine the significance of varicus parameters to its performance. The piston motion and loading of the acceleration reservoir (AR), the structural response of AR, and the projectile motion are determined. The piston is represented as an incompressible fluid while the AR is modeled with the ABAQUS finite element structural analysis code. Model results are compared with a measured profile of AR diameter growth for a test at maximum conditions and with projectile exit velocities for a group of tests. Changes in the piston density and in the break diaphragm opening pressure are shown to significantly affect the AR loading and the projectile final velocity.

22190 (SAND–93-2092C) **Safety issues in robotic handling of nuclear weapon parts.** Drotning, W.; Wapman, W.; Fahrenholtz, J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940646–3: Society of Women Engineers national convention and student conference, Pittsburgh, PA (United States), 22-24 Jun 1994). Order Number DE94011328. Source: OSTI; NTIS; INIS; GPO Dep.

Robotic systems are being developed by the Intelligent Systems and Robotics Center at Sandia National Laboratories to perform automated handling tasks with radioactive weapon parts. These systems will reduce the occupational radiation exposure to workers by automating operations that are currently performed manually. The robotic systems at Sandia incorporate several levels of mechanical, electrical, and software safety for handling hazardous materials. For example, tooling used by the robot to handle radioactive parts has been designed with mechanical features that allow the robot to release its payload only at designated locations in the robotic workspace. In addition, software processes check for expected and unexpected situations throughout the operations. Incorporation of features such as these provides multiple levels of safety for handling hazardous or valuable payloads with automated intelligent systems.

22191 (SAND–93-3886C) **Interferometric SAR phase difference calibration: Methods and results.** Bickel, D.L.; Hensley, W.H. Sandia National Labs., Albuquerque, NM (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940814–2: International geoscience and remote sensing symposium, Pasadena, CA (United States), 8-12 Aug 1994). Order Number DE94011027. Source: OSTI; NTIS; GPO Dep.

This paper addresses the steps necessary to determine and maintain the phase calibration of a two-channel interferometric synthetic aperture radar (IFSAR). The method, setup, and accuracy of four different calibration techniques are compared. The most novel technique involves pointing the interferometric baseline at nadir and imaging a lake surface. The other techniques include measuring various flat surfaces in traditional side-looking IFSAR maps, in-flight closed-loop calibration path measurements, and static laboratory measurements. Initial results indicate that, using combinations of these measurements, it is possible to maintain the interferometric phase calibration of Sandia National Laboratories' K_U Band IFSAR to better than 3 degrees. The time variability of various parts of the calibration and requirements for recalibration are also discussed.

22192 (SAND–93-3898C) **Imaging targets embedded in a lossy half space with Synthetic Aperture Radar.** Doerry, A.W.; Brock, B.C.; Boverie, B.; Cress, D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940814–1: International geoscience and remote sensing symposium, Pasadena, CA (United States), 8-12 Aug 1994). Order Number DE94010807. Source: OSTI; NTIS; GPO Dep.

This paper addresses theoretical aspects of forming images from an airborne Synthetic Aperture Radar (SAR) of targets buried below the earth's surface. Soil is generally a lossy, dispersive medium, with wide ranging variability in these attributes depending on soil type, moisture content, and a host of other physical properties. Focussing a SAR subsurface image presents new dimensions of complexity relative to its surface-image counterpart, even when the soil's properties are known. This paper treats the soil as a lossy, dispersive half space, and presents a practical model for the radar echo-delay time to point scatterers within it. This model is then used to illustrate effects of refraction, dispersion, and attenuation on a SAR's phase histories, and the resulting image. Various data collection geometries and processing strategies are examined

for both 2-Dimensional and 3-Dimensional SAR images. The conclusions from this work are that (1) focussing a SAR image must generally take into account both refraction and dispersion, (2) resolving targets at different depths in lossy soils requires perhaps unprecedented sidelobe attenuation, that for some soils may only be achievable with specialized window functions, (3) the impulse response of the soil itself places a practical limit on the usable bandwidth of the radar, and (4) dynamic ranges and sensitivities will need to be orders of magnitude greater than typical surface-imaging SARs, leading to significant impact on SAR parameters, for example compressing the usable range of pulse repetition frequencies (PRFs).

22193 (SAND–94-0228) **The Interstate-40 bridge shaker project.** Mayes, R.L.; Nusser, M.A. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 12p. Sponsored by Federal Highway Administration, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011409. Source: OSTI; NTIS; GPO Dep.

New Mexico State University organized an effort to perform static and dynamic damage-detection tests on the Interstate-40 bridge over the Rio Grande at Albuquerque. The opportunity was available because the 425-ft-long bridge was soon to be replaced. Sandia National Laboratories was asked to provide and operate a shaker that could exert 1000-lb peak amplitude forces for both sinusoidal and random excitations between 2 and 20 Hz. Two Sandia departments collaborated to design and build the shaker, using existing major components connected with Sandia-designed and -fabricated hardware. The shaker was installed and operated successfully for a series of five modal and sinusoidal response tests.

22194 (SAND–94-0308) **Impact testing of the H1224A shipping/storage container.** Harding, D.C.; Bobbe, J.G.; Stenberg, D.R.; Arviso, M. Sandia National Labs., Albuquerque, NM (United States). May 1994. 229p. Sponsored by Defense Nuclear Agency, Washington, DC (United States). DOE Contract AC04-94AL85000. Contract DNA MIPR 93-837. (TTC–1294). Order Number DE94012472. Source: OSTI; NTIS; GPO Dep.

H1224A weapons containers have been used for years by the Department of Energy and Department of Defense to transport and store W78 warhead midsections. Although designed to protect these midsections only in low-energy handling drop and impact accidents, a recent transportation risk assessment effort has identified a need to evaluate the container's ability to protect weapons in higher-energy environments. Four impact tests were performed on H1224A containers with W78 Mod 6c mass mockup midsections inside, onto an essentially unyielding target. Dynamic acceleration and strain levels were recorded during the side-on and end-on impacts, each at 12.2 m/s (40 ft/s) and 38.1 m/s (125 ft/s). Measured peak accelerations experienced by the midsections during lower velocity impacts ranged from 250 to 600 Gs for the end-on impact and 350 to 600 Gs for the side-on impact. Measured peak accelerations of the midsections during the higher velocity impacts ranged from 3,000 to 10,000 Gs for the end-on impact and 8,000 to 10,000 Gs for the side-on impact. Deformations in the H1224A container ranged from minimal to severe buckling and weld tearing. At higher impact velocities, the H1224A container may not provide significant energy absorption for the re-entry vehicle midsection but can provide some confinement of potentially damaged components.

22195 (SAND–94-0513C) **What is an open architecture robot controller?.** Ford, W.E. Sandia National Labs., Albuquerque, NM (United States). 14 Feb 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940869–1: 9. Institute of Electrical and Electronics Engineers (IEEE) international symposium on intelligent control, Columbus, OH (United States), 16-18 Aug 1994). Order Number DE94007854. Source: OSTI; NTIS; GPO Dep.

This paper addresses the issue of what is an open architecture robot controllers. Three different classifications are defined along with the various advantages and shortcomings of each approach. Knowledge from past research and new technology has been included in this analysis. The conclusions recommend a communication-based hybrid approach with well defined interfaces between modules.

22196 (SAND–94-0595C) **Robotics Technology Development Program Cross Cutting and Advanced Technology.** Harrigan, R.W.; Horschel, D.S. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–12: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008952. Source: OSTI; NTIS; INIS; GPO Dep.

Need-based cross cutting technology is being developed which is broadly applicable to the clean up of hazardous and radioactive waste within the US Department of Energy's complex. Highly modular, reusable technologies which plug into integrated system architectures to meet specific robotic needs result from this research. In addition, advanced technologies which significantly extend current capabilities such as automated planning and sensor-based control in unstructured environments for remote system operation are also being developed and rapidly integrated into operating systems.

22197 (SAND–94-0623C) **Robot trajectory planning via dynamic programming.** Dohrmann, C.R.; Robinett, R.D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–6: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008424. Source: OSTI; NTIS; GPO Dep.

The method of dynamic programming is applied to three example problems dealing with robot trajectory planning. The first two examples involve end-effector tracking of a straight line with rest-to-rest motions of planar two-link and three-link rigid robots. These examples illustrate the usefulness of the method for producing smooth trajectories either in the presence or absence of joint redundancies. The last example demonstrates the use of the method for rest-to-rest maneuvers of a single-link manipulator with a flexible payload. Simulation results for this example display interesting symmetries that are characteristic of such maneuvers. Details concerning the implementation and computational aspects of the method are discussed.

22198 (SAND–94-0827C) **Two-axis hydraulic joint for high speed, heavy lift robotic operations.** Vaughn, M.R.; Robinett, R.D.; Phelan, J.R.; VanZuiden, D.M. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–13: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94009284. Source: OSTI; NTIS; GPO Dep.

A hydraulically driven universal joint was developed for a heavy lift, high speed nuclear waste remediation application. Each axis is driven by a simple hydraulic cylinder controlled by a jet pipe servovalve. Servovalve behavior is controlled by a force feedback control system, which damps the hydraulic resonance. A prototype single joint robot was built and tested. A two joint robot is under construction.

22199 (SAND–94-0945) **Evaluation of scanners for C-scan imaging in nondestructive inspection of aircraft.** Gieske, J.H. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 60p. Sponsored by Federal Aviation Administration, Washington, DC (United States). DOE Contract AC04-94AL85000. DTFA-03-91A-0018. Order Number DE94012473. Source: OSTI; NTIS; GPO Dep.

The goal of this project was to produce a document that contains information on the usability and performance of commercially available, fieldable, and portable scanner systems as they apply to aircraft NDI inspections. In particular, the scanners are used to generate images of eddy current, ultrasonic, or bond tester inspection data. The scanner designs include manual scanners, semiautomated scanners, and fully automated scanners. A brief description of the functionality of each scanner type, a sketch, and a fist of the companies that support the particular design are provided. Vendors of each scanner type provided hands-on demonstrations of their equipment on real aircraft samples in the FAA Aging Aircraft Nondestructive Inspection Validation Center (AANC)

in Albuquerque, NM. From evaluations recorded during the demonstrations, a matrix of scanner features and factors and ranking of the capabilities and limitations of the design, portability, articulation, performance, usability, and computer hardware/software was constructed to provide a quick reference for comparing the different scanner types. Illustrations of C-scan images obtained during the demonstration are shown.

22200 (SAND–94-0970C) **Status report on the NCSL Intrinsic/Derived Standards Committee.** Pettit, R.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940770–1: 1994 national conference of standards laboratory workshop and symposium, Chicago, IL (United States), 31 Jul - 4 aug 1994). Order Number DE94010805. Source: OSTI; NTIS; GPO Dep.

The history and present status of the NCSL intrinsic/Derived Standards Committee is presented, including a review of the current published Recommended Intrinsic/Derived Standard Practices (RISPs) and the four Working Groups that are in the process of developing new RISPs. One of the documents under development is a Reference Catalogue that documents important information associated with over forty intrinsic/derived standards. The generic information on each standard in the Catalogue, as well as its Table of contents, are presented.

22201 (SAND–94-1111C) **Visual Servoing: A technology in search of an application.** Feddema, J.T. Sandia National Labs., Albuquerque, NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940550–12: Institute of Electrical and Electronics Engineers (IEEE) international conference on robotics, San Diego, CA (United States), 8-13 May 1994). Order Number DE94010803. Source: OSTI; NTIS; GPO Dep.

Considerable research has been performed on Robotic Visual Servoing (RVS) over the past decade. Using real-time visual feedback, researchers have demonstrated that robotic systems can pick up moving parts, insert bolts, apply sealant, and guide vehicles. With the rapid improvements being made in computing and image processing hardware, one would expect that every robot manufacturer would have a RVS option by the end of the 1990s. So why aren't the Fanucs, ABBs, Adepts, and Motomans of the world investing heavily in RVS? I would suggest four seasons: cost, complexity, reliability, and lack of demand. Solutions to the first three are approaching the point where RVS could be commercially available; however, the lack of demand is keeping RVS from becoming a reality in the near future. A new set of applications is needed to focus near term RVS development. These must be applications which currently do not have solutions. Once developed and working in one application area, the technology is more likely to quickly spread to other areas. DOE has several applications that are looking for technological solutions, such as agile weapons production, weapons disassembly, decontamination and dismantlement of nuclear facilities, and hazardous waste remediation. This paper will examine a few of these areas and suggest directions for application-driven visual servoing research.

22202 (SRT-CMA–930039) **Nuclear criticality safety evaluation DWPF melter – Batch 1.** Williamson, T.G. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Dec 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94007278. Source: OSTI; NTIS; INIS; GPO Dep.

The Savannah River Site (SRS) High Level Nuclear Waste will be vitrified in the Defense Waste Processing Facility (DWPF) for long term storage and disposal. This is a preliminary safety evaluation for the Melt Cell of the DWPF vitrification process for Batch 1 waste. This evaluation demonstrates that the material in the Melt cell remains subcritical for the contents of Batch 1 which contains uranium with less than 1% by weight U-235.

22203 (UCRL-CR–117148) **Real-time radiography of Titan IV Solid Rocket Motor Upgrade (SRMU) static firing test QM-2.** Dolan, K.W.; Curnow, G.M.; Perkins, D.E.; Schneberk, D.J.; Costerus, B.W.; La Chapell, M.J.; Turner, D.E.; Wallace, P.W. Lawrence Livermore National Lab., CA (United States). 8 Mar 1994. 72p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94010899. Source: OSTI; NTIS; GPO Dep.

Real-time radiography was successfully applied to the Titan-IV Solid Rocket Motor Upgrade (SRMU) static firing test QM-2 conducted February 22, 1993 at Phillips Laboratory, Edwards AFB, CA. The real-time video data obtained in this test gave the first incontrovertible evidence that the molten slag pool is low (less than 5 to 6 inches in depth referenced to the bottom of the aft dome cavity) before T + 55 seconds, builds fairly linearly from this point in time reaching a quasi-equilibrium depth of 16 to 17 inches at about T + 97 seconds, which is well below the top of the vectored nozzle, and maintains that level until T + 125 near the end motor burn. From T + 125 seconds to motor burn-out at T + 140 seconds the slag pool builds to a maximum depth of about 20 to 21 inches, still well below the top of the nozzle. The molten slag pool was observed to interact with motions of the vectored nozzle, and exhibit slosh and wave mode oscillations. A few slag ejection events were also observed.

22204 (UCRL-JC–112090) **Angle interferometer cross axis errors.** Bryan, J.B.; Carter, D.L.; Thompson, S.L. Lawrence Livermore National Lab., CA (United States). Jan 1994. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940854–1: 1994 CIRP general assembly, Singapore (Singapore), 21-27 Aug 1994). Order Number DE94006190. Source: OSTI; NTIS; GPO Dep.

Angle interferometers are commonly used to measure surface plate flatness. An error can exist when the centerline of the double corner cube mirror assembly is not square to the surface plate and the guide bar for the mirror sled is curved. Typical errors can be one to two microns per meter. A similar error can exist in the calibration of rotary tables when the centerline of the double corner cube mirror assembly is not square to the axes of rotation of the angle calibrator and the calibrator axis is not parallel to the rotary table axis. Commercial double corner cube assemblies typically have non-parallelism errors of ten milli-radians between their centerlines and their sides and similar values for non-squareness between their centerlines and end surfaces. The authors have developed a simple method for measuring these errors and correcting them by remachining the reference surfaces.

22205 (WHC-SA–2111) **Jumper connector analysis.** Kanjilal, S.K.; Lindquist, M.R.; Ulbricht, L.E. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940613–8: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94010373. Source: OSTI; NTIS; GPO Dep.

Jumper connectors are used for remotely connecting pipe lines containing transfer fluids ranging from hazardous chemicals to other nonhazardous liquids. The jumper connector assembly comprises hooks, hookpins, a block, a nozzle, an operating screw, and a nut. The hooks are tightened against the nozzle flanges by the operating screw that is tightened with a remotely connected torque wrench. Stress analysis for the jumper connector assembly (used extensively on the US Department of Energy's Hanford Site, near Richland, Washington) is performed by using hand calculation and finite-element techniques to determine the stress levels resulting from operating and seismic loads on components of the assembly. The analysis addresses loading conditions such as prestress, seismic, operating, thermal, and leakage. The preload torque-generated forces at which each component reaches its stress limits are presented in a tabulated format. Allowable operating loads for the jumper assembly are provided to prevent leakage of the assembly during operating cycles.

22206 (WHC-SA–2343) **Pressure relief valve/safety relief valve testing.** Murray, W.A.; Hamm, E.R.; Barber, J.R. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940276–4: Energy Facility Contractors Group (EFCOG) conference, San Francisco, CA (United States), 15 Feb 1994). Order Number DE94011391. Source: OSTI; NTIS; GPO Dep.

Pressure vessels and piping systems are protected form overpressurization by pressure relief valves. These safety features are required to be tested-inspected on some periodic basis and, in most cases witnessed by a third party inspector. As a result nonconformances found by third parties Westinghouse Hanford Company initiated a task team to develop a pressure safety program. This paper reveals their findings.

22207 (WHC-SA–2344) **Emery 3004 as a challenge aerosol for HEPA filter testing.** Barber, J.D.; Gilles, D.A. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940276–1: Energy Facility Contractors Group (EFCOG) conference, San Francisco, CA (United States), 15 Feb 1994). Order Number DE94010344. Source: OSTI; NTIS; GPO Dep.

HEPA filters are used in nuclear facilities for contamination control and air treatment and are constructed to be 99.97% efficient in trapping particles of 0.3 microns or larger in size. Prior to installation at Hanford facilities HEPA filters are tested against the manufacturer's efficiency specifications by the Hanford Environmental Health Foundation using an aerosol with a monodispersed particle size of 0.3 microns. The oil or material used for generating the aerosol, has historically been Dioctl Phthalate (DOP). But, in 1980 DOP was classified as a suspected carcinogen, and the search for substitute materials was under way. Corn oil produced good quantities of the correct sized particles but it tended to clog the generating equipment; Polyethylene Glycol 400 (PEG) and Dioctl Sebacate (DOS) were also tried but failed for various reasons. Emery 304 was tested and produced a good quantity of correctly sized aerosol and did not clog or damage the equipment in any way. Upon further testing, in September 1992, the DOE Richland Operations authorized the use of Emery 304 for in situ HEPA filter testing on the Hanford site.

22208 (WHC-SA–2346) **Centralized maintenance procedures.** Barber, J.R. Westinghouse Hanford Co., Richland, WA (United States). Feb 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-940276–3: Energy Facility Contractors Group (EFCOG) conference, San Francisco, CA (United States), 15 Feb 1994). Order Number DE94011392. Source: OSTI; NTIS; GPO Dep.

In 1989, shortly after Westinghouse Hanford Company (WHC) assumed maintenance responsibilities for the Hanford site, a Department of Energy (DOE) maintenance audit found that field (working level) maintenance procedures and procedure practices of the facilities scattered across Hanford's 560 square miles varied as greatly as the locations of those facilities. In some of the audited facilities there were few or no procedures; in others, procedures conflicted with or were redundant to procedures at other facilities. This document presents current efforts to centralize maintenance procedures.

22209 (WHC-SA–2361) **Operational guidance for using DOT-6M/2R packaging.** Kelly, D.L.; Hummer, J.H. Westinghouse Hanford Co., Richland, WA (United States). Mar 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9405109–3: Department of Energy defense programs packaging workshop, Knoxville, TN (United States), 16-19 May 1994). Order Number DE94009760. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this paper is to describe a new US Department of Energy (DOE), Transportation Management Division task to create a US Department of Transportation (DOT) Specification 6M/2R packaging configuration user's guide. The need for a user's guide was identified because the DOT-6M/2R packaging configuration is widely used by DOE site contractors, and DOE receives many questions about the approved packaging configurations. Currently, two DOE organizations have the authority to approve new DOT-6M/2R configurations. For Defense Programs, the Transportation and Packaging Safety Division (EH-332) administers the program. For Environmental Restoration and Waste Management, the Transportation Management Division (EM-261) administers the program.

22210 (WSRC-MS–94-005) **A remotely operated robot for decontamination tasks.** Dudar, A.M.; Vandewalle, R.C. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940859–2: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94006378. Source: OSTI; NTIS; INIS; GPO Dep.

Engineers in the Robotics Development Group at the Westinghouse Savannah River Company (WSRC) have developed a robot which will be used to decontaminate a pipe gallery of a tank farm used for nuclear waste storage. Personnel access is required into this pipe gallery to inspect existing pipes and perform repairs to secondary containment walls around the tank farm. Presently, the pipe gallery is littered with debris of various sizes and its surface is contaminated with activity levels up to 2.5E6 DPM (disintegrations per minute) alpha and exposure levels as high as 20 Rad/hr. Cleaning up this pipe gallery win be the mission of an all-hydraulic robotic vehicle developed in-house at WSRC caged the "Remote Decon" robot. The Remote Decon is a tracked vehicle which utilizes skid steering and features a six-degree-of-freedom (DOF) manipulator arm, a five-DOF front end loader type bucket with a rotating brush for scrubbing and decontaminating surfaces, and a three-DOF pan/tilt mechanism with cameras and lights. The Remote Decon system is connected to a control console via a 200 foot tethered cable. The control console was designed with ergonomics and simplicity as the main design factors and features three joysticks, video monitors, LED panels, and audible alarms.

22211 (WSRC-MS–94-008) **Overview of robotics for Mixed Waste Operations.** Ward, C.R. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940859–3: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94006379. Source: OSTI; NTIS; INIS; GPO Dep.

The Mixed Waste Operations Robotics program is developing robotics technology to make the handling and treatment of Department of Energy mixed waste; better, faster, safer and cheaper. This technology will provide remote operations and not require humans to be in contact with this radioactive and hazardous waste. The technology includes remote handling and opening of waste containers, remote removal of waste from the containers, remote characterization and sorting of the waste, and remote treatment and disposition of the waste. The initial technology development program culminated in an integrated demonstration in November 1993 and each aspect of this technology is described.

22212 (WSRC-MS–94-069) **An autonomous mobil robot to perform waste drum inspections.** Peterson, K.D.; Ward, C.R. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940859–1: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94007186. Source: OSTI; NTIS; INIS; GPO Dep.

A mobile robot is being developed by the Savannah River Technology Center (SRTC) Robotics Group of Westinghouse Savannah River company (WSRC) to perform mandated inspections of waste drums stored in warehouse facilities. The system will reduce personnel exposure and create accurate, high quality documentation to ensure regulatory compliance. Development work is being coordinated among several DOE, academic and commercial entities in accordance with DOE's technology transfer initiative. The prototype system was demonstrated in November of 1993. A system is now being developed for field trails at the Fernald site.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 20911, 21254, 21256, 21291, 21325, 21590, 21650, 22155, 22438, 22581, 22774, 23276, 23287, 23289, 23296

22213 (ANL/ES/CP–81833) **Prediction methods for single-phase turbulent flow inside tubes with wire-coil inserts.** Rabas,

T.J. Argonne National Lab., IL (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940625–5: 6. AIAA/ASME thermophysics and heat transfer conference, Colorado Springs, CO (United States), 20-23 Jun 1994). Order Number DE94012642. Source: OSTI; NTIS; GPO Dep.

Wire-coil inserts provide an efficient and inexpensive way to enhance the thermal performance of heat-exchanger tubes. For applications that require frequent cleaning, their easy-to-retrofit characteristic offers a significant advantage over integrally enhanced-tube types. However, the lack of suitable prediction methods is a major reason why wire-coil inserts are not more frequently used by industry. Heat-transfer and friction-factor comparisons of predicted values and experimental data for 39 different coil configurations taken from seven sources are presented. Two prediction methods are considered; the empirical correlations of Ravigurgurajan and Bergles (1986) and the mechanistic predictions methods of James et al. (1993). Favorable agreement existed between the predictions and the heat-transfer data. The average and root-mean-square (RMS) errors were 4 and 14, with the correlation of Ravigurgurajan and Bergles and 16 and 20 percent, with the prediction method of James et al. The Ravigurgurajan and Bergles is therefore recommended for tubes with coil inserts when the coil geometries conform to the restrictions considered in the development of the correlations. Substantially more scatter existed with the friction-factor data, and it reached a factor of two for some tubes with essentially the same coil geometry. Three possible causes are (1) the pressure drop is also a function of the tube inside diameter (lower f values obtained with the large diameters), (2) a loose fit sometimes existed between the coil and base tube, and (3) experimental error.

22214 (ANL/ET/CP–81075) **Experiment on fluidelastic instability of loosely supported tube arrays in crossflow.** Chen, S.S.; Zhu, S.; Cai, Y. Argonne National Lab., IL (United States). [1994]. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940613–19: Pressure vessel and piping conference, Minneapolis, MN (United States), 19-23 Jun 1994). Order Number DE94012463. Source: OSTI; NTIS; GPO Dep.

A tube array supported by baffle plates in crossflow may be subjected to fluidelastic instability in the tube-support-plate-inactive mode. An experimental study is presented to characterize the tube motion. Three series of tests were performed to measure tube displacements as a function of flow velocity for different clearances. The motion was examined by root-mean-square values of tube displacements, power spectral densities, phase planes, Poincare maps, and Lyapunov exponents. The experimental data agree reasonably well with the analytical model, based on the unsteady flow theory.

22215 (BNL–60075) **The effect of water subcooling on film boiling heat transfer from vertical cylinders.** Greene, G.A. (Brookhaven National Lab., Upton, NY (United States)); Irvine, T.F. Jr. Brookhaven National Lab., Upton, NY (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940809–5: 10. international heat transfer conference, Brighton (United Kingdom), 14-18 Aug 1994). Order Number DE94008705. Source: OSTI; NTIS; GPO Dep.

The effect of subcooling on the film boiling heat transfer of water from vertical copper cylinders has been investigated experimentally using a transient quench technique. A lumped parameter model was utilized since the Biot numbers were always less than 0.05. The amount of subcooling varied from 0 K to 70 K and the initial cylinder wall temperatures were of the order of 1100 K. Heat transfer coefficient were measured at the midpoint of the cylinders and were obtained over quench times in which they were verified to be constant. Subcooling had a significant effect on both the film boiling heat transfer coefficient and the minimum film boiling temperature. As the subcooling varied from 0 K to 70 K, the h transfer coefficient increased by a factor of five. As the subcooling varied from 0 K to 60 K, the minimum film boiling temperature increased from approximately 600 K to 1000 K. An attempt to correlate the heat transfer coefficient data with a method recently proposed by Sakurai et al. was only successful at subcooled temperature differences less than 10 K. A modified correlation is presented using the Sakurai et al. parameters which better represents the data over the complete subcooling range.

22216 (DOE/ER/14045–8) **Microscopic image processing systems for measuring nonuniform film thickness profiles.** Liu, A.H.; Plawsky, J.L.; DasGupta, S.; Wayner, P.C. Jr. Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Chemical Engineering. [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14045. (CONF-940809–4: 10. international heat transfer conference, Brighton (United Kingdom), 14-18 Aug 1994). Order Number DE94005336. Source: OSTI; NTIS; GPO Dep.

In very thin liquid films. transport processes are controlled by the temperature and the interfacial intermolecular force field which is a function of the film thickness profile and interfacial properties. The film thickness profile and interfacial properties can be measured most efficiently using a microscopic image processing system. IPS, to record the intensity pattern of the reflected light from the film. There are two types of IPS: an image analyzing interferometer (IAI) and/or an image scanning ellipsometer (ISE). The ISE is a novel technique to measure the two dimensional thickness profile of a nonuniform, thin film, from 1 nm up to several μm, in a steady state as well as in a transient state. It is a full field imaging technique which can study every point on the surface simultaneously with high spatial resolution and thickness sensitivity, i.e., it can measure and map the 2-D film thickness profile. Using the ISE, the transient thickness profile of a draining thin liquid film was measured and modeled. The interfacial conditions were determined in situ by measuring the Hamaker constant. The ISE and IAI systems are compared.

22217 (DOE/ER/14168–T1) **Nonlinear dynamics of fluid-structure systems: Annual technical report.** Moon, F.C.; Muntean, G. Cornell Univ., Ithaca, NY (United States). Sibley School of Mechanical and Aerospace Engineering. Jan 1994. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14168. Order Number DE94012592. Source: OSTI; NTIS; GPO Dep.

We are investigating the nonlinear dynamics of a row of cylindrical tubes excited by the cross flow of fluid. Both experimental and analytical/numerical studies have been conducted. The goal of this research is to look for low dimensional dynamic models in flow- induced vibrations using modern methods of dynamical systems and chaos theory. The experimental study uses a 25 cm x 25 cm wind tunnel with flow velocity in the range of 15 m/sec. The use of a wind tunnel to explore dynamic phenomenon compliments the work of Chen at Argonne National Laboratory who also is conducting experiments with a water tunnel. The principal nonlinearities studies are impact constraints due to gaps in the cylinder supports and nonlinear fluid forces.

22218 (DOE/PC/90183–T11) **Dense inclined flows: Theory and experiments: Quarterly technical progress report, January 1, 1994–March 31, 1994.** Jenkins, J.T.; Louge, M.Y. Cornell Univ., Ithaca, NY (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90183. Order Number DE94012605. Source: OSTI; NTIS; GPO Dep.

Rapid, gravity-driven flows of granular materials down inclines pose a challenge; even in situations in which the flow is steady and two-dimensional, the balance of momentum and energy within the flow and at the bottom boundary are not well understood. A research program was undertaken integrating theory, computer simulation, and experiment that will focus on dense entry flows down inclines. The effort involves the development of theory informed by the results of simultaneous computer simulations and the construction, instrumentation, and use of an experimental facility in which the variables necessary to assess the success or failure of the theory can be measured. In this period, we have improved the operations of the chute facility to permit a precise setting of its angle. We have also improved the microphone probe and collection vessel that records the mass holdup of particles. We have completed a series of measurements of the impact properties of acrylic

and polystyrene spheres. Finally, we have interrogated our computer simulations in an effort to refine our theoretical predictions for the flux of fluctuating energy through a flat, frictional wall.

22219 (DOE/PC/91297–T5) **A computational model for coal transport and combustion: Quarterly technical progress report, December 1, 1993–February 28, 1994.** Ahmadi, G. Clarkson Univ., Potsdam, NY (United States). Dept. of Mechanical and Aeronautical Engineering. [1994]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91297. Order Number DE94013066. Source: OSTI; NTIS; GPO Dep.

In the period of December 1, 1993 to February 28, 1994, considerable progress in the experimental study of monogranular layer simple shear flow device was made. Experimental data concerning the mean granular velocity, fluctuation velocity and solid volume fraction were obtained. The resulting data revealed new interesting features of particulate flows. The thermodynamically consistent, rate dependent model for turbulent two-phase flows and its application to analysis of simple shear flow was completed. Further progress on the application of the kinetic model for rapid flows of granular materials including the frictional energy losses were made. The flow over a vibrating plate was analyzed and the velocity, the fluctuation energy and the solid volume fraction profiles were evaluated. A computational model for analyzing flow of granular materials in ducts and passages with bumpy walls was developed. The special cases of Couette and chute flows was analyzed. The results were compared with the experimental data and good agreement was observed. Flows of gas-solid mixtures in vertical ducts were studied. A computational model for analyzing two-phase flow was developed, and the phasic mean velocity and fluctuation energy profiles were evaluated.

22220 (LA-UR–93-2435) **Unifying the controlling mechanisms for the critical heat flux and quenching: The ability of liquid to contact the hot surface: Part 3, The influence of dry-patch shape and multiple-patch interaction.** Unal, C.; Sadasivan, P.; Nelson, R.A. Los Alamos National Lab., NM (United States). [1993]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940809–1: 10. international heat transfer conference, Brighton (United Kingdom), 14-18 Aug 1994). Order Number DE93016517. Source: OSTI; NTIS; INIS; GPO Dep.

In earlier work, we proposed a hypothesis for the occurrence of critical heat flux (CHF) during pool boiling of saturated liquids. According to this gypothesis, CHF occurs when some portion of the heater surface drives and a local point with this dry patch reaches a critical rewetting temperature, beyond which liquid an no longer contact that point. In this paper, the effects of dry-patch shape and multiple-patch interactions on the critical rewetting temperature have been investigated.

22221 (LA-UR–93-3234) **Pool boiling on thin heaters: The role of thermal interaction among vapor stems.** Sadasivan, P.; Unal, C.; Nelson, R. Los Alamos National Lab., NM (United States). 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940809–2: 10. international heat transfer conference, Brighton (United Kingdom), 14-18 Aug 1994). Order Number DE94000802. Source: OSTI; NTIS; GPO Dep.

We examine the issue of thermal interactions within a heater as a possible explanation for conflicting critical heat flux data on thin heaters, as reported by various investigators. While heater thermal properties have been considered in previous studies, the focus of this study is the interaction between the thermal transport process within the heater and the distribution of nucleation sites on the heater surface. It is shown that the spatial distribution of stems on the heater surface, as well as the size distribution of these stems, can affect the average surface temperatures. Such interactions are greater as the heater thickness decreases.

22222 (SAND–93-1707C) **Shear-drive flow in a square cavity: A comparative study using PIV, LDV, and computational simulations.** O'Hern, T.J. (Sandia National Labs., Albuquerque, NM (United States)); Torczynski, J.R.; Blanchat, T.K.; Chu, T.Y.; Tassin, A.L. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940659–7: 1994 ASME (Americal Society of Mechanical Engineers) fluids engineering summer meeting, Lake Tahoe, NV (United States), 19-23 Jun 1994). Order Number DE94010806. Source: OSTI; NTIS; GPO Dep.

The shear-driven flow in a cavity is examined using two experimental techniques and computations. Unlike the more commonly studied lid-driven cavity, the flow in the cavity of interest here is driven by a fully developed laminar channel flow passing over the top of the cavity. The experimental techniques applied are laser Doppler velocimetry (LDV) and video-based particle-tracking particle image velocimetry (PIV). The computational simulations are performed using the commercial finite element CFD code FIDAP. The cavity Reynolds number ranged from 100 to 900 in the experiments, and from 0 to 1000 in the simulations. Results of the various techniques are compared, and found to be in fairly good agreement.

22223 (SAND–94-0839C) **Flow visualization for Lagrangian particle methods.** Glass, M.W.; Kempka, S.N. Sandia National Labs., Albuquerque, NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405139–1: 1994 international American Vacuum Society users conference, Boston, MA (United States), 2-4 May 1994). Order Number DE94010757. Source: OSTI; NTIS; GPO Dep.

In particle methods, each particle represents a finite region over which there is a distribution of the field quantity of interest. The field value at any point is calculated by summing the distribution functions for all the particles. This summation procedure does not require the use of any connectivities to generate continuous fields. Various AVS modules and networks have been developed that enable us to visualize the results from particle methods. This will be demonstrated by visualizing a numerical simulation of a rising, chaotic bubble. In this fluid dynamics simulation, each particle represents a region with a specified vorticity distribution.

22224 (SAND–94-8503C) **Dynamics of the flame surface area in turbulent nonpremixed combustion.** Kollmann, W. (Univ. of California, Davis (United States). MAE Dept.); Chen, J.H. Sandia National Labs., Livermore, CA (United States). [1994]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940838–1: 25. combustion symposium, Irvine, CA (United States), 1 Aug 1994). Order Number DE94004975. Source: OSTI; NTIS; GPO Dep.

The dynamic equation for the total surface area of level surfaces is developed based on a theorem of geometric measure theory and its relation to other versions of the equation is established. The mixture fraction, a quantity which is relevant to non-premixed combustion, is used to define the level surfaces. The level surface corresponding to its stoichiometric value is defined as the flame surface. It is shown that the evolution of the surface properties is determined by the rate-of-strain generated by the motion of the fluid, coupled with molecular diffusion and source terms of the scalar variable defining the level surface. DNS results obtained for a low-Reynolds number turbulent non-premixed flame are used to evaluate the effects of strain rate and scalar dynamics on the surface area of level surfaces.

22225 (WAPD-T–3026) **Void fraction measurements of acrylic discs via neutron radiography.** Glickstein, S.S.; Joo, H.; Vance, W.H.; Murphy, J.H. Westinghouse Electric Corp., West Mifflin, PA (United States). Bettis Atomic Power Lab. [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-93PN38195. (CONF-940602–9: 35. annual meeting of the American Nuclear Society, New Orleans, LA (United States), 11-16 Jun 1994). Order Number DE94010810. Source: OSTI; NTIS; GPO Dep.

Simulation experiments have been initiated to verify that neutron radiography methods can accurately measure void fractions under various operating conditions in a steam-water flow channel. Recent neutron radiography experiments measured void fractions in an air-water channel at atmospheric pressure and room temperature conditions. Because steam-water densities at atmospheric pressure and low temperature vary significantly from those at high pressure and high temperature, questions have been raised as to the ability

of the neutron radiographic technique to deduce vapor fractions under various steam-water operating conditions. In response to this concern, the macroscopic neutron cross sections presented by two extreme steam-water conditions were simulated using acrylic discs containing various size holes. Acrylic, which contains hydrogen as a major constituent closely resembles the properties of water as seen by a thermal neutron beam. Through holes appear to the neutrons as steam voids at atmospheric pressure. The effect of increased vapor density, (and neutron macroscopic cross section), which would occur at high pressure, was simulated by not drilling the holes completely through the discs. The shallow hole plus the remaining material was made to simulate a through hole filled with a vapor density on the order of 14% of water. The measured void fractions deduced from digitally imaged neutron radiographs are in good agreement with the expected values for the two cases studied.

4205 Materials Testing

Refer also to citation(s) 20660, 20876, 21111, 21843, 21937, 21954, 21956, 21959, 21962, 21980, 21981, 21982, 22015, 22031, 22185, 23251, 23301

22226 (BNL–49762) **Plastic buckling of cylindrical shells.** Bandyopadhyay, K. (Brookhaven National Lab., Upton, NY (United States)); Xu, J.; Shteyngart, S.; Eckert, H. Brookhaven National Lab., Upton, NY (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940659–8: 1994 ASME (Americal Society of Mechanical Engineers) fluids engineering summer meeting, Lake Tahoe, NV (United States), 19-23 Jun 1994). Order Number DE94011921. Source: OSTI; NTIS; GPO Dep.

Cylindrical shells exhibit buckling under axial loads at stresses much less than the respective theoretical critical stresses. This is due primarily to the presence of geometrical imperfections even through such imperfections could be very small (e.g., comparable to thickness). Under internal pressure, the shell regains some of its buckling strength. For a relatively large radius-to-tickness ratio and low internal pressure, the effect can be reasonably estimated by an elastic analysis. However, for low radius-to-thickness ratios and greater pressures, the elastic-plastic collapse controls the failure load. In order to quantify the elastic-plastic buckling capacity of cylindrical shells, an analysis program was carried out by use of the computer code BOSOR5 developed by Bushnell of Lockheed Missiles and Space company. The analysis was performed for various radius-to- thickness ratios and imperfection amplitudes. The analysis results are presented in this paper.

22227 (CNIC–00725) **The technique for determination of surface contamination by uranium on U_3Si_2-Al plate-type fuel elements.** Li Shulan (China Nuclear Power Inst., Chengdu (China)); He Fengqi; Wang Qingheng; Han Jingquan. China Nuclear Information Centre, Beijing, BJ (China). Apr 1993. 8p. (In Chinese). (SINRE–0038.). Order Number DE94626278. Source: OSTI; NTIS (US Sales Only); INIS.

The NDT method for determining the surface contamination by uranium on U_3Si_2-Al plate-type fuel elements, the process of standard specimen preparation and the graduation curve are described. The measurement results of U_3Si_2-Al plate-type fuel elements show that the alpha counting method to measure the surface contamination by uranium on fuel plate is more reliable. The UB-1 type surface contamination meter, which was recently developed, has many advantages such as high sensitivity to determine the uranium pollution, short time in measuring, convenience for operation, and the minimum detectable amount of uranium is 5×10^{-10} g/cm^2. The measuring device is controlled by a microcomputer. Besides data acquisition and processing, it has functions of statistics, output data on terminal or to printer and alarm. The procedures of measurement are fully automatic. All of these will meet the measuring needs in batch process.

22228 (CONF-8806529–1) **Amplitude and phase acoustic microscopy and its application to QNDE.** Khuri-Yakub, B.T.; Reinholdtsen, P.; Chou, C.H.; Parent, P.; Cinbis, C. Stanford Univ., CA (United States). Edward L. Ginzton Lab. Jun 1988. 11p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract FG03-84ER45157. Contract N00014-86K-0433. From International symposium on acoustical imaging; Sendai (Japan); Jun 1988. Order Number DE94012347. Source: OSTI; NTIS; GPO Dep.

The authors have two amplitude and phase measuring acoustic microscopes, one at low frequency (3–10 MHz) which is used for measurements in metals and composites, and the other operating at frequencies of up to 200 MHz which is used for higher resolution measurements. The added dimension of having phase information allows one to use image processing for a variety of applications. They have demonstrated the following applications with these two microscopes: inversion for reflectance function calculations, depth determination for delaminations in composite materials, slowness curve measurements of depth of trenches in aluminum samples (scaled problem of silicon trenches), and measurement of viscoelastic properties of thin surfactant films on a water surface.

22229 (CONF-880760–12) **Acoustic microscopy with mixed-mode transducers.** Chou, C.H.; Parent, P.; Khuri-Yakub, B.T. Stanford Univ., CA (United States). [1988]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-84ER45157. From 15. annual review of progress in quantitative nondestructive evaluation; La Jolla, CA (United States); 31 Jul - 5 aug 1988. Order Number DE94012344. Source: OSTI; NTIS; GPO Dep.

The new amplitude-phase acoustic microscope is versatile; it operates in a wide frequency range 1–200 MHz, with selection of longitudinal, shear, and mixed modes. This enables it to be used in many NDE applications for different kinds of materials. Besides the application examples presented in this paper (bulk defect imaging of lossy materials or at deep locations; leads of IC chip in epoxy package; amplitude images of surface crack on Si nitride ball bearing; thin Au film on quartz), this system can also be applied for residual stress and anisotropy mapping with high accuracy and good spatial resolution. 7 refs, 6 figs.

22230 (SAND–94-1278C) **Development of high sensitivity techniques for characterizing outgassing of polymeric construction materials for microenvironments.** McIntyre, D.C.; Thornberg, S.M.; Liang, A.Y.; Bender, S.F.A.; Lujan, R.D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940510–7: 40. annual technical meeting and exposition of the Institute of Environmental Sciences (IES), Rosemont, IL (United States), 1-6 May 1994). Order Number DE94012068. Source: OSTI; NTIS; GPO Dep.

Further reductions in particulate contamination in semiconductor device manufacturing environments will be required to meet the future challenges of producing devices with decreased dimensions. Using pods (microenvironments) to provide very clean environments on a local (wafer level) scale is an alternative that may reduce the technological demands and cost of providing comparable contamination levels in an entire clean-room manufacturing facility. It has been demonstrated that pods can provide wafer environments that have lower and less variable levels of particulate contamination than conventional clean-room manufacturing environments. However, there have also been indications that outgassed constituents from polymeric pod materials can condense on wafers during storage. A standard technique to evaluate outgassing of polymers is needed so that: (1) manufacturers can make reliable comparisons of the outgassing potential of materials being considered for use and (2) microenvironment users can make judgments on the relative outgassing threats from different manufacturers' products. The goal of the work that is summarized below has been to develop standard high sensitivity (10–100 ppb) testing techniques for evaluation of outgassing from polymeric pod materials in a temperature range from 30 C–75 C. This paper will briefly review outgassing data from polycarbonate materials that was obtained using thermal desorption combined with detection using gas chromatography/mass spectroscopy wit volatile preconcentration or using a flame ionization detector (FID). Although the focus of this program has been on developing techniques to evaluate pod materials of construction, the techniques that have

been evaluated may be useful for characterizing outgassing from other polymeric materials found in cleanrooms.

4210 Combustion Systems

Refer also to citation(s) 20660, 21018, 21289, 21290

22231 (DOE/PC/91160–T2) **Development and testing of a high efficiency advanced coal combustor phase III industrial boiler retrofit: Quarterly technical progress report No. 9, 1 October 1993–31 December 1993.** Jennings, P. (ABB/Combustion Engineering, Windsor, CT (United States)); Borio, R.; Scaroni, A.W.; Miller, B.G.; McGowan, J.G. ABB Combustion Engineering, Windsor, CT (United States). Power Plant Labs. 1 Mar 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91160. Order Number DE94013055. Source: OSTI; NTIS; GPO Dep.

This report documents the technical aspects of this project during the ninth quarter of the program. During this quarter, the natural gas baseline testing at the Penn State demonstration boiler was completed, results were analyzed and are presented here. The burner operates in a stable manner over an 8/1 turndown, however due to baghouse temperature limitations (300°F for acid dewpoint), the burner is not operated for long periods of time below 75% load. Boiler efficiency averaged 83.1% at the 100 percent load rate while increasing to 83.7% at 75% load. NO_x emissions ranged from a low of 0.17 Lbs/MBtu to a high of 0.24 Lbs/MBtu. After the baseline natural gas testing was completed, work continued on hardware optimization and testing with the goal of increasing carbon conversion efficiency on 100% coal firing from ≈95% to 98%. Several coal handling and feeding problems were encountered during this quarter and no long term testing was conducted. While resolving these problems several shorter term (less than 6 hour) tests were conducted. These included, 100% coal firing tests, 100% natural gas firing tests, testing of air sparges on coal to simulate more primary air and a series of cofiring tests. For 100% coal firing, the carbon conversion efficiency (CCE) obtained this quarter did not exceed the 95-96% barrier previously reached. NO_x emissions on coal only ranged from ≈ 0.42 to ≈ 0.78 Lbs/MBtu. The burner has not been optimized for low NO_x yet, however, due to the short furnace residence time, meeting the goals of 98% CCE and <0.6 Lbs/MBtu NO_x simultaneously will be difficult. Testing on 100% natural gas in the boiler after coal firing indicated no changes in efficiency due to firing in a 'dirty' boiler. The co-firing tests showed that increased levels of natural gas firing proportionately decreased NO_x, SO_2, and CO.

4220 Mining and Underground Engineering

Refer also to citation(s) 20711

22232 (LA-SUB–94-33) **Thermal spallation drilling: Final report.** Miska, S. (New Mexico Inst. of Mining and Technology, Socorro, NM (United States)); Williams, R.E.; Potter, R.M. Los Alamos National Lab., NM (United States); New Mexico Inst. of Mining and Technology, Socorro, NM (United States). 30 Apr 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013607. Source: OSTI; NTIS; GPO Dep.

Work that was performed on a previous contract with the Los Alamos National Laboratory and subsequent work at NM Tech indicated that an intermittent heating and cooling cycle, produced by heating with the conventional blast from a small jet engine and then cooled with a stream of water, would prove to be successful in spalling additional rocks. New Mexico Tech has attempted to further the use of spallation drilling to suit applications for mining and oil and gas drilling by showing that the use of a heating and cooling system would successfully penetrate otherwise unspallable rocks. This process, while showing some success in previous experimentation, has proved to work only spasmodically. The rocks tested had zones that were not spallable or were so slowly spallable that non-uniform holes were produced. Because of these irregularities, further field experimentation is not now profitable.

22233 (SAND–94-1192C) **Equations of state for explosive detonation products: The PANDA model.** Kerley, G.I. Sandia National Labs., Albuquerque, NM (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–12: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011429. Source: OSTI; NTIS; GPO Dep.

Includes vugraphs.

This paper discusses a thermochemical model for calculating equations of state (EOS) for the detonation products of explosives. This model, which was first presented at the Eighth Detonation Symposium, is available in the PANDA code and is referred to here as "the Panda model". The basic features of the PANDA model are as follows. (1) Statistical-mechanical theories are used to construct EOS tables for each of the chemical species that are to be allowed in the detonation products. (2) The ideal mixing model is used to compute the thermodynamic functions for a mixture of these species, and the composition of the system is determined from assumption of chemical equilibrium. (3) For hydrocode calculations, the detonation product EOS are used in tabular form, together with a reactive burn model that allows description of shock-induced initiation and growth or failure as well as ideal detonation wave propagation. This model has been implemented in the three-dimensional Eulerian code, CTH.

4250 Power Cycles

Refer also to citation(s) 21855

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 21226, 21932, 22035, 22039, 22044, 22164, 22229, 22406, 22407, 22414, 22422, 23217, 23218

22234 (BNL–60378) **Specifying the surface finish of x-ray mirrors.** Church, E.L. (Army Armament Research and Development Command, Dover, NJ (United States)); Takacs, P.Z. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9305159–10: Optical Society of America (OSA) topical meeting on soft x-ray projection lithography, Monterey, CA (United States), 10-12 May 1993). Order Number DE94013537. Source: OSTI; NTIS; GPO Dep.

Our measurements of x-ray mirrors at Brookhaven indicate that the power spectral densities of their finish errors have inverse power-law or fractal forms, rather than being flat at low frequencies as is usually assumed. This paper reviews these data and discusses how this apparent divergent behavior leads to finite but unconventional effects in imaging. Results are then used to develop more rational and realistic surface-finish specifications.

22235 (CONF-940592–Absts.) **Fourth international colloquium on x-ray lasers: Book of abstracts.** Lawrence Livermore National Lab., CA (United States). [1994]. 155p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. From 4. international colloquium on X-ray lasers; Williamsburg, VA (United States); 16-20 May 1994. Order Number DE94012076. Source: OSTI; NTIS; GPO Dep.

This report contains abstracts from the fourth international colloquium on x-ray lasers.

22236 (ENEA-RT-INN–93-04) **Microwave FEL design with waveguide and wiggler tapering.** Dipace, A. (ENEA, Frascati (Italy). Centro Ricerche Energia - Area Energia e Innovazione); Sabia, E.; Boscolo, I. ENEA, Frascati (Italy). Centro Ricerche Energia - Area Energia e Innovazione. Apr 1993. 19p. (RT/INN–93-04). Order Number DE94775298. Source: OSTI; NTIS (US Sales Only).

This paper discusses a new design for a very high efficiency FEL (free electron laser) amplifier in the microwave band, based on the waveguide and wiggler tapering technique. Up to 75% efficiency is reported, even in a relatively relaxed wiggler design.

22237 (ENEA-RT-INN–93-06) **Saturation dynamics in FEL and optical-klystron FEL devices.** Dattoli, G. (ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta); Giannessi, L.; Torre, A.;

Galli, M.; Ottaviani, P.L. ENEA, Frascati (Italy). Centro Ricerche Energia - Area Energia e Innovazione. Apr 1993. 21p. (RT/INN–93-06). Order Number DE94775309. Source: OSTI; NTIS (US Sales Only).

This note presents an analysis of free electron laser (FEL) saturation mechanisms with particular attention to the case of optical-Klystron (OK) devices operating with low energy e-beams in the single passage configuration. A discussion is made of the range of validity of already introduced FEL gain vs intensity saturation formulae and it is show that OK FEL saturation occurs in two distinct steps. In the first, the dispersive. section is 'turned-off'; and in the second, saturation in the conventional sense is reached.

22238 (ENEA-RT-INN–93-09) **One-dimensional simulation of FEL including high gain regime, saturation, prebunching and harmonic generation: Part 1.** Dattoli, G. (ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta); Galli, M.; Ottaviani, P.L. ENEA, Frascati (Italy). Centro Ricerche Energia - Area Energia e Innovazione. May 1993. 41p. (RT/INN–93-09). Order Number DE94775310. Source: OSTI; NTIS (US Sales Only).

A one-dimensional simulation of free electron laser (FEL) dynamics, including high gain, saturation, harmonic generation, optical-Klystron, etc., is developed. The validity of the numerical analysis is checked by an accurate comparison with the available analytical formulation and a significant agreement between the two approaches is shown. Particular attention is devoted to the physical aspects of the dynamic interplays between saturation and harmonic generation mechanisms.

22239 (LA-SUB–94-32) **Support for development of a custom VLSI and FPGA logic chips based on a VHDL top-down design approach: Final report.** Los Alamos National Lab., NM (United States); InnovASIC, Inc., Albuquerque, NM (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013608. Source: OSTI; NTIS; GPO Dep.

The objective of this contract was to perform the beginning stages of development for two Application Specific integrated Circuits: CMOS-1 and CMOS-2D. This work includes specification writing, behavioral modeling, and beginning design. In addition, the design work is required to be done in the VHSIC Hardware Description Language (VHDL). InnovASIC, Inc. completed all the tasks required of this contract. The specifications were written, VHDL for CMOS-1 was completed, a behavioral model of CMOS-2D was written, and a system simulation was performed.

22240 (SAND–94-0221) **Modified Noise Power Ratio testing of high resolution digitizers.** McDonald, T.S. Sandia National Labs., Albuquerque, NM (United States). May 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012471. Source: OSTI; NTIS; GPO Dep.

A broadband, full signal range, side-by-side (tandem) test method for estimating the internal noise performance of high resolution digitizers is described and illustrated. The technique involves a re-definition of the traditional Noise Power Ratio (NPR) test, a change that not only makes this test applicable to higher resolution systems than was previously practical, but also enhances its value and flexibility. Since coherence analysis is the basis of this new definition, and since the application of coherence procedures to high resolution data poses several problems, this report discusses these problems and their resolution.

22241 (SAND–94-0383) **Laser drilling of printed wiring boards: Final report on work sponsored by Sandia LDRD program.** Arzigian, J.S. Sandia National Labs., Albuquerque, NM (United States). May 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011004. Source: OSTI; NTIS; GPO Dep.

Traditionally, electrical connections- between layers of a printed wiring board are formed by mechanically drilling holes through all layers and then plating the resulting structure to provide electrical connections between the layers. The mechanical drilling process is very capital- and labor-intensive and is often a bottleneck in board production. The goal of this program was the development of laser drilling as an alternative to mechanical drilling. Cost advantages and the ability to produce smaller holes were both of interest. Although it had initially been intended to develop all processes at Sandia, suitable emerging processes and materials were identified in industry during the course of the work. Because of these industry efforts, it was decided to terminate the LDRD efforts after the first year of work and to pursue collaborative development efforts with industrial partners. A laser drilling facility is currently being developed at Sandia to pursue this work further.

22242 (SAND–94-0834) **Sandia Lightning Early Warning Network: Digital-based upgrade.** Boyd, G.M. Sandia National Labs., Albuquerque, NM (United States). May 1994. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011412. Source: OSTI; NTIS; GPO Dep.

This report describes the layout and operation of the recently upgraded Sandia Lightning Early Warning Network, which was upgraded from an analog-based to a digital-based telemetry system.

22243 (SAND–94-0912C) **Evaluating plastic assembly processes for high reliability applications using HAST and Assembly Test Chips.** Emerson, J.A.; Sweet, J.N.; Peterson, D.W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940596–4: 44. electronic components and technology conference, Washington, DC (United States), 1-4 May 1994). Order Number DE94010750. Source: OSTI; NTIS; GPO Dep.

We demonstrate the use of HAST and Assembly Test Chips to evaluate the susceptability of epoxy molding compounds to moisture induced corrosion of Al conductors. We show that the procedure is sufficiently sensitive to discriminate between assembly processes used by different molding facilities. Our data show that the location in time of the "knee" in the failure distribution is dependent on material properties of the epoxy. Reducing the failure rate in the early or "extrinsic" region of the time-failure distribution is key to achieving high reliability. Wt examine the failure modes in the extrinsic region for test chips encapsulated with a number of high quality molding compounds in an attempt to better understand this region.

22244 (UCRL-ID–116758) **U-turn alternative to the large aperture switch.** Vann, C.S. Lawrence Livermore National Lab., CA (United States). 9 Mar 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94011541. Source: OSTI; NTIS; GPO Dep.

The primary alternative laser architecture is the U-turn design. The U-turn has significantly different cost and performance risks than the full-aperture switch, which makes it a highly desirable alternative. The U-turn was conceived at LLNL in 1992. A similar concept, the L-turn had already been discovered by the French at CEL-V. Both concepts are based on the multipass glass amplifier design, but the full-aperture Pockels cell and polarizer are replaced with smaller and less expensive optics. Eliminating the large switch and polarizer not only reduces component costs, it also provides options for shortening the laser which, in turn, could reduce the size and cost of the laser building. Efficient use of the amplifier aperture (small vignetting allowance) requires that the U-turn have a long transport spatial filter; however, this is not a disadvantage if a long spatial filter is already required for image relaying to the frequency converter. Given a long spatial filter, the U-turn is potentially more efficient because losses in the switch and polarizer are avoided.

22245 (UCRL-ID–117008) **Frequency doubling of copper lasers using temperature-tuned ADP.** Molander, W.A. Lawrence Livermore National Lab., CA (United States). Mar 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94011542. Source: OSTI; NTIS; GPO Dep.

The ability to generate high average power uv at 255 nm by frequency doubling the green line (510.6 nm) of copper lasers would greatly extend the utility of copper lasers. Material processing and microlithography are two areas of interest. The frequency-doubled copper laser could replace the KrF excimer laser, which has a similar wavelength (248 nm), in some applications. The frequency-doubled copper laser has a narrow linewidth and excellent beam

quality at a competitive cost. Other attractive features are high reliability, low operating costs, and the absence of toxic gases. This paper will report recent progress in high-efficiency, high-average-power harmonic generation of the copper laser green line using noncritical phase matching in ADP. Frequency doubling of the yellow line (578.2 nm) and sum-frequency mixing of the two lines are also of interest. These processes, however, cannot be phase-matched in ADP and, therefore, will not be discussed here. The results reported and the issues identified here would be important in these other processes and also in many other frequency conversion schemes in the uv such as 4ω conversion of Nd^{3+}:YAG lasers.

22246 (UCRL-ID–117029) **Diode array alternative to paint removal solid-state cw laser.** Comaskey, B. Lawrence Livermore National Lab., CA (United States). 29 Dec 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94011482. Source: OSTI; NTIS; GPO Dep.

The purpose of this memo is to highlight an alternative to the approach for cw laser paint removal. The point to be made is that a direct diode design is feasible and can be far more competitive than a solid-state laser based system. Through by-passing the use of a solid-state laser media, we immediately gain a factor of about five in system efficiency based on measured optical-to-optical efficiencies of our average power diode pumped lasers. This permits a massive reduction in system cooling requirements. It should be noted that cooling system size was the greatest concern voiced by Gordon McFadden at Hobart Lasers with regards to his Nd:YAG laser systems operated in field applications. Furthermore, with direct diode use far fewer diode packages will be needed to deliver a given amount of wattage on the target. This will largely eliminate the intimidating sticker shock and shorten (proportionally by the diode count) the required run-to-fail times demanded of the system.

22247 (UCRL-JC–115687-Rev.1) **High average power pulsed phase conjugate laser with birefringence correction: Revision 1.** Bowers, M.W. (Lawrence Livermore National Lab., CA (United States). Advanced Development Group); Hankla, A.K.; Jacobson, G.F. Lawrence Livermore National Lab., CA (United States). May 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940582–1-Rev.1: CLEO '94: conference on lasers and electro-optics, Anaheim, CA (United States), 8-13 May 1994). Order Number DE94012062. Source: OSTI; NTIS; GPO Dep.

Nd:YAG rod lasers have been plagued with the inability to go to high average powers because of thermally induced birefringence and focusing. Several methods have been employed to correct for the birefringence and the thermal aberrations of such systems, but place stringent constraints on the laser heads and/or the system alignment. They have developed a scalable Nd: YAG master oscillator/power amplifier (MOPA) laser system which employs a novel phase conjugation scheme to correct both for the material and thermal distortions as well as the thermal birefringence in double pass amplifier systems. This method reduces the double pass depolarization from 42% to less than 2% and is easy to align.

22248 (UCRL-JC–116042) **Ionization balance and gain calculations for neon-like selenium x-ray laser plasmas.** Osterheld, A.L. (and others); Walling, R.S.; Young, B.K.F. Lawrence Livermore National Lab., CA (United States). 21 Jan 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211211–6: Radiative properties of hot dense matter conference, Santa Barbara, CA (United States), 2-6 Nov 1992). Order Number DE94012590. Source: OSTI; NTIS; GPO Dep.

The authors have developed compact collisional-radiative models to describe the ionization balance and excitation mechanisms in neon-like selenium x-ray laser plasmas. These models can be used for calculations of the ionization dynamics, detailed emission spectra, and gain coefficients. Careful attention has been paid to indirect processes such as dielectronic recombination, excitation-autoionization, and resonant excitation. They discuss the importance of different atomic processes and model approximations in the ionization balance and gain calculations. These results will be compared to experimental measurements and to previous calculations.

22249 (UCRL-JC–116299) **A rejection method for selection of scattered states.** Lawson, W.S. Lawrence Livermore National Lab., CA (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405147–1: 3. international workshop on computational electronics, Portland, OR (United States), 18-20 May 1994). Order Number DE94012232. Source: OSTI; NTIS; GPO Dep.

A rejection method is presented that sidesteps much of the labor necessary in the usual techniques for choosing a scattered state after an electron-phonon collision with full band structure. The phonon wave number is chosen randomly, then tested to see if the resultant collision will satisfy energy conservation to within some accuracy. If not, the collision is rejected, and if so, then the wave number is adjusted in order to enforce energy conservation more precisely. The price one pays is in a high rejection rate. if the cost of a rejection is small, however, this rejection rate can be tolerated. This method will not compete with analytical models (near valley minima), but may outperform the more usual techniques. Accuracies of a few percent are practical. Simulations were preformed with the first conduction band of gallium arsenide.

22250 (UCRL-JC–116300) **Time-step stability for self-consistent Monte Carlo device simulation.** Rambo, P.W.; Denavit, J. Lawrence Livermore National Lab., CA (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405147–3: 3. international workshop on computational electronics, Portland, OR (United States), 18-20 May 1994). Order Number DE94012145. Source: OSTI; NTIS; GPO Dep.

An important numerical constraint on self consistent Monte Carlo device simulation is the stability limit on the time step imposed by plasma oscillations. The widely quoted stability limit for the time step between Poisson field solutions, $\Delta t<2/\omega_p$ where ω_p is the plasma frequency, is specific to the leapfrog particle advance used in collisionless plasma simulation and does not apply to typical particle advance schemes used for device simulation. The authors present a stability criterion applicable to several algorithms in use for solid state modeling; this criterion is verified with numerical simulation. This work clarifies the time step limitation due to plasma oscillations and provides a useful guide for the efficient choice of time step size in Monte Carlo simulation. Because frequent solution of the Poisson equation can be a sizable computational burden, methods for allowing larger time step are desirable. The use of advanced time levels to allow stability with $\omega_p\Delta t\gg 1$ is well known in the simulation of collisionless plasmas; they have adapted these implicit methods to semiconductor modeling and demonstrated stable simulation or time steps larger than the explicit limit.

22251 (UCRL-JC–116301) **Time-dependent simulations of filament propagation in photoconducting switches.** Rambo, P.W. (Lawrence Livermore National Lab., CA (United States)); Lawson, W.S.; Capps, C.D.; Falk, R.A. Lawrence Livermore National Lab., CA (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405147–2: 3. international workshop on computational electronics, Portland, OR (United States), 18-20 May 1994). Order Number DE94012146. Source: OSTI; NTIS; GPO Dep.

The authors present a model for investigating filamentary structures observed in laser-triggered photoswitches. The model simulates electrons and holes in two-dimensional cylindrical (r-z) geometry, with realistic electron and hole mobilities and field dependent impact ionization. Because of the large range of spatial and temporal scales to be resolved, they are using an explicit approach with fast, direct solution of the field equation. A flux limiting scheme is employed to avoid the time-step constraint due to the short time for resistive relaxation in the high density filament. Self-consistent filament propagation with speeds greater than the carrier drift velocity are observed in agreement with experiments.

22252 (UCRL-JC–116700) **New hollow-cathode electrode for high-power copper lasers.** Chang, J.J.; Alger, T.W.; Anderson, A.T.; Arnold, P.A. Lawrence Livermore National Lab., CA (United States). 9 Mar 1994. 4p. DOE Contract W-7405-ENG-48. (CONF-940582–4: CLEO '94: conference on lasers and electro-optics, Anaheim, CA (United States), 8-13 May 1994). Order Number DE94011637. Source: OSTI; NTIS; GPO Dep.

Multiple hollow-cathode slots were utilized on a profiled solid-copper electrode taht extended stable glow discharge to higher pressures in copper lasers. This novel electrode design, which dramatically reduced discharge jitter and window contamination, has been run for more than 8000 hours with very little degradation.

22253 (UCRL-JC–116764) **>100 watt average power at 0.53 μm with 25 ns, 2.5 kHz repetition rate pulses from a single power oscillator.** Velsko, S.P.; Comaskey, B.; Albrecht, G.F.; Beach, R.J. Lawrence Livermore National Lab., CA (United States). Mar 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9404135–3: 5. international symposium on high power lasers and applications, Vienna (Austria), 5-8 Apr 1994). Order Number DE94011641. Source: OSTI; NTIS; GPO Dep.

We have generated approximately 100 watts of frequency doubled light from the output of an electro-optically Q-switched, diode-pumped Nd:YAG slab laser oscillator operating at an average power of 200 watts (2.5 kHz repetition rate, 80 mJ/pulse, 25 ns pulsewidth). The Q-switch was a compensated z-axis propagation $LiNbO_3$ electro-optic modulator, and the frequency conversion crystal was a thin slab of KTP. In addition, Q-switched operation at an average power of approximately 250 watts with 26 ns pulsewidths has been demonstrated.

22254 (UCRL-JC–116999) **250 watt average power electro-quality Q-switched diode pumped power oscillator.** Velsko, S.P.; Ebbers, C.A.; Comaskey, B.; Albrecht, G.F.; Mitchell, S.C. Lawrence Livermore National Lab., CA (United States). Apr 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940226–7: 9. advanced solid-state lasers meeting, Salt Lake City, UT (United States), 7-10 Feb 1994). Order Number DE94011644. Source: OSTI; NTIS; GPO Dep.

We describe an electro-optically Q-switched, diode-pumped ND:YAG slab laser oscillator operating at an average power of greater than 250 watts. More than 100 watts of frequency doubled light has been demonstrated.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 21715

22255 (INIS-mf–14207) **Deutsches Elektronen-Synchrotron DESY. Scientific annual report 1991.** Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Nov 1991. 310p. (In German). Order Number DE94773743. Source: OSTI; NTIS (US Sales Only); INIS.

The scientific annual report 1991 presented by DESY again is a very detailed summary of the activities. The HERA activities reported for the most part deal with the preparatory work for the scientific programme for electron-proton collisions in HERA, and with the modified DORIS III electron-positron storage ring. But at the time this annual report will have been published, the physics studies at HERA will have yielded the first and certainly interesting scientific results, and there also are scientific results available of experiments with the newly installed beam guides in DORIS. (orig.)

4301 Design, Development, and Operation

Refer also to citation(s) 21129

22256 (BNL–60158) **Conceptual Design Report for a Phase 3 upgrade of the National Synchrotron Light Source.** Foyt, W.; Krinsky, S.; Hastings, J. (eds.); Finlay, L. Brookhaven National Lab., Upton, NY (United States). Mar 1994. 298p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013590. Source: OSTI; NTIS; GPO Dep.

Considerable investment by both the Department of Energy and the facility's Participating Research teams has permitted the NSLS to offer a national facility to a wide range of scientific pursuits. The purpose of the NSLS Phase III project is to maximize the scientific output of this premier 2nd generation synchrotron radiation facility through a number of distinct projects. Over the years the NSLS has made significant improvements in the area of beam reliability which has resulted in deliverable, reproducible beam during 98% and 97% of scheduled operations on the VUV and X-ray rings respectively. This project will focus on improving beam intensity and stability by upgrading the optics and detector systems on a number of beamlines as well as upgrading radio frequency (rf) and beam position monitoring systems in the storage rings. In addition, the project includes plans for the design and procurement of a utility isolation system that would guard against voltage transients that disrupt the facility's electrical system. Also a new insertion device will be installed at beamline X25 and a 2nd floor will be constructed over the X6 – X16 region which will provide sorely needed laboratory and office space for the user community. This project requests funding of 22.5 million dollars over a three year period: FY 1996 ($6.3M), FY 1997 ($13.4M) and FY 1998 ($2.8M).

22257 (DOE/ET/53088–659) **Proof-of-principle experiments of laser Wakefield acceleration.** Nakajima, K. (National Lab. for Higher Energy Physics, Ibaraki (Japan)); Kawakubo, T.; Nakanishi, H. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Apr 1994. 14p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States);Ministry of Education, Science and Culture (Japan). DOE Contract FG05-80ET53088. (IFSR–659). Order Number DE94012767. Source: OSTI; NTIS; INIS; GPO Dep.

Recently there has been a great interest in laser-plasma accelerators as possible next-generation particle accelerators because of their potential for ultra high accelerating gradients and compact size compared with conventional accelerators. It is known that the laser pulse is capable of exciting a plasma wave propagating at a phase velocity close to the velocity of light by means of beating two-frequency lasers or an ultra short laser pulse. These schemes came to be known as the Beat Wave Accelerator (BWA) for beating lasers or as the Laser Wakefield Accelerator (LWFA) for a short pulse laser. In this paper, the principle of laser wakefield particle acceleration has been tested by the Nd:glass laser system providing a short pulse with a power of 10 TW and a duration of 1 ps. Electrons accelerated up to 18 MeV/c have been observed by injecting 1 MeV/c electrons emitted from a solid target by an intense laser impact. The accelerating field gradient of 30 GeV/m is inferred.

22258 (INIS-mf–13606, pp. 9) **Nuclear resonance as utilized in the study of materials.** Zironi, E.P. (Universidad Nacional Autonoma de Mexico, Mexico City (Mexico). Inst. de Fisica); Rickards, J. Instituto Nacional de Investigaciones Nucleares, Mexico City (Mexico); Sindicato Unico de Trabajadores de la Industria Nuclear (SUTIN), Mexico City (Mexico). 1991. 29p. (In Spanish). (CONF-9105428–: 2. national meeting on accelerators, Salazar (Mexico), 22-24 May 1991). In *Programme and summaries of the 2. national meeting on accelerators.* Order Number DE94602209. Source: OSTI; NTIS (US Sales Only); INIS.

The 700 KeV Van de Graaff at the Institute of Physics was used to study various elements in solids and thin films by nuclear reaction resonance techniques (NRR). The intense and relatively narrow resonance at 340 KeV of the ^{19}F (p, $\alpha\ \gamma$) O^{16} reaction proved particularly sensitive in determining this element. In the majority of the materials of an order of 0.01 mg/cm^2 and sensitivity of an order of 10^{19} atoms/cm^3 a depth resolution F was found using a 1 KeV typical beam resolution and a resonance width of 2.4 KeV. A microcomputer program was developed to calculate the excitation curve given a certain F profile which has been applied in different cases. Some examples of F in poisoned thin film of $Sn\ O_2$ and $Si\ O_2$, teflon, etc., are presented. (Author).

22259 (INIS-mf–13808, pp. 172) **Present state of the LHC project at CERN.** Koziol, H. (European Organization for Nuclear Research, Geneva (Switzerland)). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CERN/accelerators; CERN; ACCELERATORS; SPECIFICATIONS; SUPERCONDUCTING MAGNETS

22260 (INIS-mf–13808, pp. 177) **The large collision machines of the future.** Regler, M. (Oesterreichische Akademie der Wissenschaften, Vienna (Austria). Inst. fuer Hochenergiephysik). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ACCELERATORS/specifications; ACCELERATORS; SPECIFICATIONS

22261 (INIS-mf–13808, pp. 178) **AUSTRON - a neutron spallation source in Austria.** Schuster, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRON SOURCES/spallation; AUSTRIA; SPALLATION

22262 (JAERI-M–93-250) **History of the JAERI linac facility for 33 years: Construction, research and shutdown.** Ohkubo, Makio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Mizumoto, Motoharu; Nakajima, Yutaka; Mashiko, Katsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 60p. (In Japanese). Order Number DE94770825. Source: OSTI; NTIS; INIS.

The JAERI electron linear accelerator will be shutdown and disassembled at the end of 1993. At the JAERI, a prototype 20 MeV linac was constructed at 1960, and was used for the neutron time-of-flight experiments and for the isotope productions. An upgraded 120 MeV linac was constructed at 1972, and was used for many fields of research works until 1993. History of the JAERI Linac and the results of the works made using these facilities are reviewed, and also R/D on the accelerator engineering are described briefly. (author).

22263 (KEK–93-12) **PRIME: a synchrotron of a phased program for JHP: Design report, 1.** Yamane, Isao; Adachi, Toshikazu; Katoh, Takao; Kawakubo, Tadamichi; Ninomiya, Shigeshi; Yano, Yoshiharu; Oomori, Chihiro. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1993. 128p. (In Japanese). Order Number DE94770614. Source: OSTI; NTIS; INIS.

This report describes a preliminary conceptual design of a high intensity proton synchrotron proposed in a phased program for JHP. A short discussion is devoted to the accelerator system necessary for the first stage of the phased program. The present status of the development study for the JHP 1 GeV proton linac is also described in order to show the properties of the injected H^- beam. Then, it describes results of design work on main components of the synchrotron; the ring lattice, the injection system, the extraction system, synchrotron magnets and its power supply and the radiofrequency accelerating system. Results of computer simulation on the process of beam painting are also given for some painting methods. (author).

22264 (LBL–35112) **Annual meeting of the Advanced Light Source Users' Association.** Lawrence Berkeley Lab., CA (United States). Mar 1994. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9310258–: 6. annual meeting of the Advanced Light Source Users meeting, Berkeley, CA (United States), 21-23 Oct 1993). Order Number DE94011902. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains discussions on: Welcome to the annual meeting of the ALS User's Association; overview of the ALS; the ALS into the 21st century; report from the DOE; scientific program at the ALS; plans for industrial use of the ALS; progress in beamline commissioning and overview of new projects; ALS user program; the fluorescent x-ray microprobe beamline at the ALS; the early days of x-ray optics; high-resolution soft x-ray spectroscopy; soft x-ray emission spectroscopy; x-ray dichroism; and application of VUV undulator beamline to chemical dynamics at the ALS.

22265 (NIRS-M–89) **Heavy ion medical accelerator in chiba: A design summary and update.** Hirao, Y. (and others); Ogawa, H.; Yamada, S. National Inst. of Radiological Sciences, Chiba (Japan). Dec 1992. 39p. Order Number DE94770587. Source: OSTI; NTIS; INIS.

The HIMAC (Heavy Ion Medical Accelerator in Chiba) construction project has been promoted by NIRS (National Institute of Radiological Sciences) as one of the projects of 'Comprehensive 10 year Strategy for Cancer Control' HIMAC is the first heavy-ion accelerator dedicated to medicine in the world, and its design parameters are based on the radiological requirements. It consists of two types of ion sources, an RFQ and an Alvarez linacs, dual synchrotron rings, high energy beam transport lines, and irradiation facilities for treatment and experiments. This report mainly describes the outline of the structure and performance of each HIMAC subsystem. (J.P.N.).

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 22235, 22236, 22237, 23277

22266 (BNL–49801) **Tune modulation due to gradient ripple and the dynamic aperture.** Parzen, G. Brookhaven National Lab., Upton, NY (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940618–3: 4. European particle accelerator conference, London (United Kingdom), 27 Jun - 1 jul 1994). Order Number DE94011922. Source: OSTI; NTIS; INIS; GPO Dep.

A tracking study was done of the effects of a tune modulation, due to a gradient ripple in the quadrupoles, on the dynamic aperture. The tracking runs were for about 1×10^6 turns. The dependence of the dynamic aperture on the frequency of the gradient ripple was also studied.

22267 (BNL–60457) **A Spin Tracking Program for Siberian snakes.** Courant, E.D. Brookhaven National Lab., Upton, NY (United States). May 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013527. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. BEAM DYNAMICS/n codes; BEAM DYNAMICS/spin orientation; EQUATIONS OF MOTION; FORTRAN; BROOKHAVEN RHIC

22268 (BNL–60490) **RHIC spin: The first polarized proton collider.** Roser, T. Brookhaven National Lab., Upton, NY (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940514–1: Intersections of particle and nuclear physics, St. Petersburg, FL (United States), 31 May - 6 jun 1994). Order Number DE94013760. Source: OSTI; NTIS; INIS; GPO Dep.

The very successful program of QCD and electroweak tests at the high energy hadron colliders have shown that the perturbative QCD has progressed towards becoming a "precision" theory. At the same time, it has been shown that with the help of Siberian Snakes it is feasible to accelerate polarized protons to high enough energies where the proven methods of collider physics can be used to probe the spin content of the proton but also where fundamental tests of the spin effects in the standard model are possible. With Siberian Snakes the Relativistic Heavy Ion Collider (RHIC) will be the first collider to allow for 250 GeV on 250 GeV polarized proton collisions.

22269 (JAERI-M–94-025) **On FEL integral equation and electron energy loss in intermediate gain regime.** Takao, Masaru (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 12p. Order Number DE94770631. Source: OSTI; NTIS; INIS.

The FEL pendulum equation in a intermediate gain small signal regime is investigated. By calculating the energy loss of the electron beam in terms of the solution of the pendulum equation, we confirm the consistency of the FEL equation in intermediate gain regime. (author).

22270 (KEK-PROC–92-15, pp. 555-557) **Modelling and optimization of beams dynamics in linac.** Edamenko, N. (Leningradskij Gosudarstvennyj Univ., Leningrad (Russian Federation)); Ovsyannikov, D.; Zhabko, A.; Kabanov, V. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Problems of acceleration and focusing in linear accelerators are considered. A general mathematical problem of charged particle beam control is formulated. Methods and algorithms of solving these problems are developed. Problems of mathematical simulation of beam dynamics are discussed in detail. Some beam quality functionals depending on all particle tracks are proposed. Mathematical methods are used for choosing parameters of forming systems. Designed codes allow to simulate and optimize beam dynamics. (author).

22271 (LA-UR–94-1360) **Fluorescence-based video profile beam diagnostics: Theory and experience.** Sandoval, D.; Gilpatrick, D.; Shinas, M.; Garcia, R.; Yuan, V.; Zander, M. Los Alamos National Lab., NM (United States). [1994]. 11p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9310204–17: Beam instrumentation workshop, Santa Fe, NM (United States), 20-23 Oct 1993). Order Number DE94011724. Source: OSTI; NTIS; GPO Dep.

Inelastic collisions between accelerated particles and residual gas in the accelerator vessel can cause the residual gas to fluoresce. The gas fluorescence intensity is proportional to the current density of the particle beam. This process provides the foundation for a video diagnostic system to measure the profile and position of accelerated particle beams. This, in fact, has proven to be a useful diagnostic at several installations. This paper describes the light production process resulting from beam – residual gas interactions and gives formulas for estimating the beam radiance for various conditions. Ground Test Accelerator (GTA) radiance calculations will be used as an example. In addition, measurement experiences with the GTA video diagnostics system will be discussed.

22272 (LBL–35324) **Suppression of beam-break-up in a standing wave free electron laser two-beam accelerator.** Li, H.; Kim, J.S. Lawrence Berkeley Lab., CA (United States); Lawrence Livermore National Lab., CA (United States). Mar 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ; W-7405-ENG-48. (CBP–72; CONF-940142–38: OE/LASE '94: conference on optics, electro-optics, and laser applications in science and engineering, Los Angeles, CA (United States), 22-29 Jan 1994). Order Number DE94011348. Source: OSTI; NTIS; INIS; GPO Dep.

Various schemes are examined in this study on the suppression of beam break-up (BBU) in a standing wave free electron laser two-beam accelerator (SWFEL/TBA). Two schemes are found to be not only able to effectively suppress the BBU but at the same time have minimum effect on the microwave generation process inside the SWFEL cavities. One is making the cavity-iris junction sufficiently gradual and the other is stagger-tuning the cavities.

22273 (SAND–94-0694) **Preradiation studies for non-thermal Z-pinch wire load experiments on Saturn.** Sanford, T.W.L. (Sandia National Labs., Albuquerque, NM (United States)); Humphreys, D.R.; Poukey, J.W.; Marder, B.M.; Halbleib, J.A.; Crow, J.T.; Spielman, R.B.; Mock, R.C. Sandia National Labs., Albuquerque, NM (United States). Jun 1994. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013459. Source: OSTI; NTIS; GPO Dep.

The implosion dynamics of compact wire arrays on Saturn are explored as a function of wire mass m, wire length ℓ, wire radii R, and radial power-flow feed geometry using the ZORK code. Electron losses and the likelihood of arcing in the radial feed adjacent the wire load are analyzed using the TWOQUICK and CYLTRAN codes. The physical characteristics of the implosion and subsequent thermal radiation production are estimated using the LASNEX code in one dimension. These analyses show that compact tungsten wire arrays with parameters suggested by D. Mosher and with a 21-nH vacuum feed geometry satisfy the empirical scaling criterion $I/(M/\ell) \sim 2$ MA/(mg/cm) of Mosher for optimizing non-thermal radiation from z pinches, generate low electron losses in the radial feeds, and generate electric fields at the insulator stack below the Charlie Martin flashover limit thereby permitting full power to be delivered to the load. Under such conditions, peak currents of ~5 MA can be delivered to wire loads ~20 ns before the driving voltage reverses at the insulator stack, potentially allowing the m = 0 instability to develop with the subsequent emission of non-thermal radiation as predicted by the Mosher model.

22274 (SSCL-SR–1225, pp. 677-679) **Longitudinal wakefield focusing: An unconventional approach to reduce the bunch length in Tevatron.** Gerasimov, A. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Achieving a shorter bunch length in Tevatron would provide a better information on the primary vertex and will allow the collider experiments to use shorter vertex detector. It would also allow an increase of luminosity by a further reduction of the β-functions at the interaction point. The conventional path to this goal by using higher RF voltages or increasing the number of RF cavities appears however prohibitively expensive. The author porposes here an alternative solution of "wakefield focusing" building on the ideas of Alexei Burov for electron storage rings. The physics of the wakefield focusing can be explained as follows: the rear particles in the bunch are affected by the front particle wakefields, but not vice versa. Therefore, for the flat (step-function) wakefield the rear particles will be stronger decelerated by the wakefields than the front ones. For the energies above transition, the longitudinal "mass" is negative, and the reduction in energy incurs the reduction in the revolution period. Subsequently, above transition the rear particles will tend to "catch up" with the front ones, so that the wakefields will provide an extra focusing and the bunch length is reduced. Below transition, the effect of the wakefield is opposite and the bunch length is increased. It is assumed that the wakefields decay within one revolution period, so that the corresponding impedance is the broadband one.

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Refer also to citation(s) 21851, 22043, 22261, 22340, 22351, 22368, 22372, 22373, 22416, 22420, 23278, 23304

22275 (BNL–49348) **Test of eight superconducting arc quadrupoles for RHIC.** Wanderer, P. (and others); Anerella, M.; Ganetis, G. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930926–34: 13. international conference on magnet technology, Victoria (Canada), 20-24 Sep 1993). Order Number DE94013752. Source: OSTI; NTIS; INIS; GPO Dep.

Test results from a group of eight superconducting quadrupoles at Brookhaven National Laboratory are presented. The magnets have been designed for use in the arc regions of the Relativistic Heavy Ion Collider now under construction at Brookhaven. Novel features of the design include a single-layer coil, the use of injection-molded phenolic for the pole spacers, and a yoke that also serves as a collar. This R&D series has been used to verify the magnet quench performance and field quality prior to the start of the production run in industry.

22276 (BNL–49438) **Photonics for accelerator instrumentation.** Stillman, A. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9310204–16: Beam instrumentation workshop, Santa Fe, NM (United States), 20-23 Oct 1993). Order Number DE94011925. Source: OSTI; NTIS; INIS; GPO Dep.

Nonlinear optical effects in certain types of crystals have the capacity to improve the performance of sampling circuits by a large margin. The theory on nonlinear optics and the associated devices is rather straightforward. I will present some of the relevant ideas and illustrate how these principles can result in order of magnitude improvements in sampling circuits. As an example of the photonic technique, I will illustrate how to design a beam position monitor that uses a nonlinear crystal.

22277 (BNL–52424) **Gas cooled leads: Part 1, Theoretical study.** Shutt, R.P.; Rehak, M.L.; Hornik, K.E. Brookhaven National Lab., Upton, NY (United States). 7 Dec 1993. 100p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94013361. Source: OSTI; NTIS; INIS; GPO Dep.

The intent of this paper is to cover as completely as possible and in sufficient detail the topics relevant to lead design. The first part identifies the problems associated with lead design, states the mathematical formulation, and shows the results of numerical and analytical solutions. The second part presents the results of a parametric study whose object is to determine the best choice for cooling method, material, and geometry. These findings axe applied in a third part to the design of high-current leads whose end temperatures are determined from the surrounding equipment. It is found that cooling method or improved heat transfer are not critical once good heat exchange is established. The range $5 < RRR < 100$ is found to be acceptable for the relative resistivity ratio of the material. Use of high transition temperature super conductor materials is not warranted for this application. The optimal geometry (L:length, A:cross-section) for given current (1) follows the relation $LI/A = 2 \times 10^5$ but extends over a large of values. Mass flow needed to prevent thermal runaway varies linearly with current above a given threshold. Below that value, the mass flow is constant with current. Transient analysis shows no evidence of hysteresis. If cooling is interrupted, the mass flow needed to restore the lead to its initially cooled state grows exponentially with the time that the lead was left without cooling.

22278 (BNL–60497) **Review of electron beam microinstabilities and their relevance to EBIS devices.** Hershcovitch, A. Brookhaven National Lab., Upton, NY (United States). 31 May 1994. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9406180–2: 6. international symposium on electron beam ion sources and their applications, Stockholm (Sweden), 20-23 Jun 1994). Order Number DE94013755. Source: OSTI; NTIS; INIS; GPO Dep.

Plasma kinetic theory and some examples of microinstabilities are briefly reviewed. Although the velocity space configuration of any EBIS is inherently susceptible to a number of classical beam microinstabilities, the small radial dimension of an EBIS plasma may prevent modes from occurring in EBIS traps due to physical limitation. In EBIS devices with high electron beam compression, where the potential for beam microinstabilities is great, the radial dimension is smaller than the Debye length, which renders plasma kinetic theory invalid. Potential for parametric instabilities exists due to coupling of structure excited modes into plasma modes by various mode-mode coupling "decay" processes.

22279 (BNL–60508) **A time-of-flight spectrometer for SuperEBIS: Informal report.** Kponou, A.; Hershcovitch, A.; McCafferty, D.; Usack, F. Brookhaven National Lab., Upton, NY (United States). 2 Jun 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AGS/AD–94-3). Order Number DE94013730. Source: OSTI; NTIS; INIS; GPO Dep.

A time-of-flight (TOF) spectrometer for determining ion species and charge states which are produced by ion sources has been constructed. It will be used to analyze the output of SuperEBIS, an Electron Beam Ion Source (EBIS) presently being assembled at BNL. Its design closely follows that of Weisgerber, which is based on the original work of Mamyrin. The spectrometer has been tested with an ion beam from a MEVVA ion source using titanium and uranium cathodes.

22280 (BNL–60509) **Magnetic field measurements of the superEBIS superconducting magnet: Informal report.** Herschcovitch, A.; Kponou, A.; Clipperton, R.; Hensel, W.; Usack, F. Brookhaven National Lab., Upton, NY (United States). 2 Jun 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AGS/AD–94-1). Order Number DE94013729. Source: OSTI; NTIS; INIS; GPO Dep.

SuperEBIS was designed to have a solenoidal magnetic field of a 5 Tesla strength with a 120 cm long bore. The field was specified to be straight within 1 part in 10000 within the bore, and uniform to within 1 part in 1000 within the central 90 cm. Magnetic field measurements were performed with a computerized magnetic field measuring setup that was borrowed from W. Sampson's group. A preliminary test was made of a scheme to determine if the magnetic and mechanical axes of the solenoid coincided, and, if not, by how much.

22281 (BNL–60510) **MeVVA source of primary metallic ions for SuperEBIS: Informal report.** Hershcovitch, A.; Kponou, A.; McCafferty, D. Brookhaven National Lab., Upton, NY (United States). 2 Jun 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AGS/AD–94-2). Order Number DE94013733. Source: OSTI; NTIS; INIS; GPO Dep.

Generation of high charge state heavy metallic ions including uranium has been successful in a number of EBIS (Electron Beam Ion Source) devices. The best results have been obtained in devices utilizing injection of primary, low charge state, ions from an external ion source into the EBIS trap for further ionization into higher charge states. In one such device, named EBIT (Electron Beam Ion Trap), a MeVVA ion source is used as an injector of primary metallic ions into the EBIT trap. The authors fabricated and experimented with a MeVVA metallic ion source. This source was recently installed on SuperEBIS, and has successfully injected titanium and uranium ions into the SuperEBIS trap.

22282 (CONF-940777–1) **Simulation of the coil winder for the superconducting supercollider.** Carnal, C.L. (Tennessee Technological Univ., Cookeville, TN (United States). Electrical Engineering Dept.); Wysor, R.W.; Lind, R.F.; Hylton, J.O. Oak Ridge National Lab., TN (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1994 summer computer simulation conference; San Diego, CA (United States); 18-20 Jul 1994. Order Number DE94012655. Source: OSTI; NTIS; INIS; GPO Dep.

A unique apparatus has been designed to shape the magnet windings for the Superconducting Supercollider (SSC). The magnet windings of the SSC consist of conductor coils which are placed around a torus to generate a strong magnetic field within the torus. Several process variables must be controlled to demanding tolerances during the coil winding operation. The speed of conductor payout must be coordinated from a small spool through two stages of roll formers to the final coil shape on a large bobbin. The amount of plastic deformation in the conductor must be tightly controlled to pack it into the large bobbin with a certain desired force. The control problem consists of multiple interacting control loops. This paper describes a computer simulation of the coil winding apparatus. The Advanced Continuous Simulation Language (ACSL) was used to encode a mathematical model of the system. The objectives of the simulation study were to understand the dynamic behavior of the system and to explore strategies for control. Although the funding for the SSC was canceled, the results of the research and development project for construction of this unique facility will find application in other large-scale construction and manufacturing problems.

22283 (DESY–93-161) **Investigations toward the development of polarized and unpolarized high intensity positron sources for linear colliders.** Floettmann, K. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany); Hamburg Univ. (Germany). Fachbereich 12 - Physik. Nov 1993. 111p. Order Number DE94768959. Source: OSTI; NTIS (US Sales Only); INIS.

In a conventional source, high energy electrons are used as primary particles to generate an electromagnetic shower in a thick target. In contrast we consider a source, based on the conversion of high energy photons in a thin target. The photons are generated in a wiggler or undulator. A source of this kind was invented in 1979 by V.E. Balakin and A.A. Mikhailichenko for the production of polarized positrons. Beside the possibility of generating polarized positrons, a source based on the conversion of photons offers also

important advantages with respect to the maximum obtainable intensities. Future linear colliders require positron sources, able to deliver intensities up to two orders of magnitude higher than existing sources. The first part of this paper deals with the intensity problem. The following advantages arise for a source based on photon conversion: I The multiple-scattering of the particles is reduced in the thin target, hence the positrons are produced with higher phase-space density and the capture efficiency is increased by a factor of ≈5. II Since the target is thin (< one radiation length), one is able to use a low Z material with high heat capacity. A comparison of various materials shows that the positron density in the target can be up to an order of magnitude higher in a titanium-alloy target than in a tungsten-rhenium-alloy target. After optimizing all components of the source (i.e. photon source, target and capture optics), parameters of a high intensity positron source (up to 4.10^{14} e^+/s) are summarized. Problems of the source operation are discussed. The second part of the paper concerns the possibilities of a polarized source. In order to take care of the processes in the shower, the calculation of polarization states has been introduced into the already existing Monte-Carlo program EGS 4, so that a complete simulation of the polarized source is possible. (Abstract Truncated)

22284 (FNAL/C–94/092) **DBS – An rlogin multiplexer and output logger for DA systems.** Oleynik, G.; Appleton, L.; Udumula, L.; Votava, M. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–6: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013219. Source: OSTI; NTIS; INIS; GPO Dep.

DART Bootstrap Services (dbs) is the first component of run-control for the DART Data Acquisition system – the DA for the 96' round of experiments at Fermilab – though it has potential usefulness as a powerful tool in other distributed applications. dbs is an rlogin session multiplexer. It allows a user, running a single program, to start up any number of remote login sessions, feed shell commands to them, and collect their output into a single (or multiple) log files (a server keeps the sessions open and collects their output). From this program, any session can be attached to interactively so it appears just like an rlogin session – dbs becomes transparent. When finished with this interactive mode, the user can escape back to dbs and attach to a different session if so desired. Among many other useful features, dbs supplies a mechanism for cleanup (deletion) of all processes created under a session, allowing a fresh start.

22285 (FNAL/C–94/104) **Data flow manager for DART.** Berg, D.; Black, D.; Slimmer, D.; Engelfried, J.; O'Dell, V. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–5: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013236. Source: OSTI; NTIS; INIS; GPO Dep.

The DART Data Flow Manager (dfm) integrates a buffer manager with a requester/provider model for scheduling work on buffers. Buffer lists, representing built events or other data, are queued by service requesters to service providers. Buffers may be either internal (reside on the local node), or external (located elsewhere, e.g., dual ported memory). Internal buffers are managed locally. Wherever possible, dfm moves only addresses of buffers rather than buffers themselves.

22286 (FNAL/C–94/112) **Analyzing terabytes of data at Fermilab.** Wolbers, S. Fermi National Accelerator Lab., Batavia, IL (United States). May 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–4: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013149. Source: OSTI; NTIS; INIS; GPO Dep.

Computing demands of High Energy Physics are increasing steadily due to the demands of larger datasets and increasingly sophisticated detector systems and analysis techniques. Fermilab has been meeting these demands by the use of many different computing techniques. Most of these techniques attempt to utilized the most cost-effective computing resources while providing effective solutions to the problems that are created by multi-Terabyte data samples and large collaborations. New strategies are being developed to allow improved access to the data.

22287 (INIS-mf–13808, pp. 31) **Relativistic secondary beams of heavy ions. From neutron halo to fission of heavy uranium fragments.** Muenzenberg, G. (Gesellschaft fuer Schwerionenforschung mbH, Planckstrasse 1, D 64291 Darmstadt (Germany)). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ION BEAMS/heavy ion reactions; HYDROGEN 1 TARGET; NUCLEAR FRAGMENTS; NUCLEAR STRUCTURE; RELATIVISTIC RANGE

22288 (JINR-E–9-93-441) **Design of a new 10 GHz ECRIS with a hexapole of continuous easy axis orientation.** Efremov, A. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions); Kutner, V.; Zao Hongwei. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1993. 14p. Order Number DE94626254. Source: OSTI; NTIS (US Sales Only); INIS.

A new 10 GHz ECR ion source for the ion production of high intensity and high charge state is being planned to build at the Laboratory of Nuclear Reactions, JINR. The main point about the design of this source is that we try to get a very simple and cheap ECR source with a flexible structure which could be variable during operation according to different purposes. This source will be equipped with a new hexapole with continuous easy axis orientation. Because of such new hexapole, this source is very compact with a simple structure, lower electric power consumption (less than 40 kw), lower cooling pressure and relatively low price. In addition, a very compact and cheap UHF (ultra high frequency) generator with an output power 800 W will be used in this source. An intense axial magnetic field up to 1.2 T and a sufficient field distribution are obtained by a fine optimization. Two different field configurations with and without iron puller will be tested. The designed structure makes it easy to change field configuration from one to another. The comparison with CAPRICE and GANIL (Grand Accelerateur National a Ions Lourds) ECR4 (Electron Cyclotron Resonance) are described. The detailed calculations of cooling water pressure for the solenoids and the double wall chamber are presented, and at last the features and prospects for the application of this source are reviewed. (author.). 10 refs.; 4 figs.; 2 tabs.

22289 (JINR-R–9-93-374) **Separated muon beams of small size in the low-background laboratory of the JINR phasotron.** Dem'yanov, A.V.; Drebushko, A.E.; Kononenko, G.A.; Mamedov, T.N.; Roganov, V.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1993. 10p. (In Russian). Order Number DE94626249. Source: OSTI; NTIS (US Sales Only); INIS.

The formation of separated 90 and 125 MeV/c muon beams of small size (several cm^2) used in studies of μ-catalysis in the low-background laboratory of the JINR phasotron is presented. The beams are formed in the beam channel II with the aid of two slot collimators situated inside the vacuum beam pipe of channel III at a distance of 6 m from the target. The number of 90 MeV/c muons stopping in a 2.5-2.5-0.5 cm styrene target amounts to 115 particles per second for a 1μA extracted proton beam; the admixture of electrons was 3%, of pions - 0.4%. (author.). 4 refs.; 2 figs.; 2 tabs.

22290 (JINR-R–9-93-431) **The potentialities of ion beam diagnostics by photoelectrons with an angular asymmetry parameter β_0 =-1.** Artemov, A.S.; Avidzba, A.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 12p. (In Russian). Order Number DE94626244. Source: OSTI; NTIS (US Sales Only); INIS.

For the photoelectrons, produced with an angular asymmetry parameter β_0 = -1, by numerical simulation the corresponding 'own' distributions in the space of transverse momenta and energy of the

laboratory frame, are obtained. The potentialities of beam diagnostics are considered for the case when information about its parameters is passed to a flux of these electrons as the result of single-photon ionization of ions in a beam or intermediate particles, taking out beam information outside. Alongside to this, relatively small polarization influence of probing photon target on the repetition accuracy of phase space portrait of the beam by photoelectrons, is taking place. (author.). 13 refs.; 9 figs.

22291 (JINR-R–13-93-420) **Scintillation hodoscope for accelerating beams: Proposal.** Kondrashov, V.D.; Kuz'michev, A.R.; Larin, A.A.; Lustov, N.M.; Mal'tsev, A.A.; Mal'tsev, M.A.; Fedunov, A.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 7p. (In Russian). Order Number DE94626259. Source: OSTI; NTIS (US Sales Only); INIS.

A system for detection of optical radiation and on-line diagnostics of special sized of beam and particle density distribution is described. The system is based on two hodoscope photomultipliers, scintillators, fiber optics line of transfer and electronic blocks. The system is intended for beam monitoring at the c-τ- factory and synchrophasotron accelerating complex at energies 20 MeV - 10 GeV and intensity range of 10^3-10^8 part./cm^2. The optical parts, detector construction, hardware and software are briefly described. (author.). 2 refs.; 3 figs.; 1 tab.

22292 (KEK–93-10) **Slow extraction system of the KEK-PS.** Shoji, Y.; Marutsuka, K.; Toyama, T.; Sato, H. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1993. 35p. Order Number DE94770612. Source: OSTI; NTIS; INIS.

Half-integer resonance extraction at $2\nu_H$=15 has been utilized for the KEK 12-GeV Proton Synchrotron (KEK-PS). Performance of the slow extraction has been progressing recently. A slow beam extraction system was constructed for the newly build North Counter Hall. For the old East Counter Hall, the power rating of the slow extraction instruments was improved in connection with an elongation of the flat-top. The quality of the extracted beam (extraction efficiency, beam emittances and spill structure) has been systematically measured and improved by concentrated efforts. Further, a new variation of the extraction modes (deuteron beam extraction and lower energy beam extraction) has been achieved in order to contribute to the various fields of physical experiments. This report gives up-to-date descriptions of the slow extraction system of the KEK-PS. (author).

22293 (KEK–93-11) **Injection error monitor for KEK 12 GeV PS.** Shirakata, Masashi (Tsukuba Univ., Ibaraki (Japan). Inst. of Applied Physics); Sato, Hikaru; Toyama, Takeshi; Marutsuka, Katsumi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1993. 27p. Order Number DE94770613. Source: OSTI; NTIS; INIS.

The injection error monitor is now being developed for an easy tuning of the main ring beam injection at the KEK 12 GeV proton synchrotron. It is expected to perform the automatic injection tuning for the main ring by using this monitor system. The beam trajectory and the tuning ability of the injection equipment on the horizontal phase plane are obtained and confirmed by a test bench system. The injection error monitor has been proved to be efficient for the beam injection tuning. (author).

22294 (KEK-PROC–92-14, pp. 1-5) **Recent status of SSC magnets.** Bush, T. (Superconducting Super Collider Lab., Dallas, TX (United States)); Allen, D.C.; Coombes, R.; Malnar, R.J.; Sanger, P.; Tompkins, J.C. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

Eighteen 5cm aperture, 15m long dipole magnet prototypes have been produced and cold-tested at Brookhaven National Laboratory (BNL) and Fermi National Accelerator Laboratory (FNAL) under contract with Superconducting Super Collider Laboratory (SSCL). These magnets are the last phase of a research and development program aimed at demonstrating the feasibility of the 5cm aperture design developed by BNL and FNAL. They are also used as vehicles to transfer technology from the national laboratories to the collider dipole magnet contractors. The BNL magnets, which rely on a horizontally split yoke and the FNAL magnets, which rely on a vertically split yoke, perform according to their somewhat different mechanical design and have equally successful quench performance. Magnets of both designs, however, exhibit a strong sensitivity to the current ramp rate, which appears to be caused by large eddy currents. These is as yet no clear explanation of why the cables used in these magnets show more AC-loss than previous cable. Preliminary investigations reveal possible links to changes in processing of the strand, cable and coil that affect the RRR, ductility, and surface condition of the cable. (author).

22295 (KEK-PROC–92-14, pp. 6-14) **Recent status of LHC magnets.** Siegel, N. (European Organization for Nuclear Research, Geneva (Switzerland)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

CERN is proceeding with the design and development of a new high energy accelerator collider, the Large Hadron Collider (LHC), consisting of a double ring, enabling the circulation of counter-rotating beams of particles of like sign. This machine is to be installed in the existing 27km long tunnel of LEP, the electron-positron collider in operation at CERN since 1989. To fit available tunnel space and reach the collision energy of interest, twin-aperture magnets with central bore fields between 8 and 10 Tesla are in development. The magnet system comprises about 1300 twin-aperture, up to 13.5m long dipole units, about 500 twin-aperture, 250T/m, 3.2m long quadrupole units and a large number of other superconducting magnetic elements. A considerable magnet R and D programme is underway, comprising the construction of short models and full length prototypes. The short twin-aperture model dipoles were tested successfully up to cable short sample current at 4.2K, but exhibited substantial training in reaching that limit at 1.8K. The causes of this behaviour are under investigation and a programme of new model magnets has been started. The construction of ten 10m dipole prototypes and of two 3m quadrupole prototypes is progressing, and, after testing, they will be assembled into a test lattice cell of the LHC. The paper describes the present state of the R and D work for the LHC magnets, reviewing their features, recent test results and aims of future developments. (author).

22296 (KEK-PROC–92-14, pp. 15-18) **Heat generation and cooling of SSC magnets at high ramp rates.** Snitchler, G. (Superconducting Super Collider Lab., Dallas, TX (United States)); Capone, D.; Kovachev, V.; Schermer, R. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

This presentation will address a summary of AC loss calculations (SSCL), experimental results on cable samples (Westinghouse STC), short model magnets test results (FNAL, KEK-Japan), and recent full length magnets test data on AC losses and quench current ramp rate sensitivity (FNAL, BNL). Possible sources of the observed enhanced heat generation and quench sensitivity for some magnets will be discussed. A model for cooling conditions of magnet coils considering heat generation distribution and specific anisotropy of the heat transfer will be presented. The crossover contact resistance in cables and curing procedure influence on resistivity, currently under study, will be briefly discussed. (author).

22297 (KEK-PROC–92-14, pp. 56-68) **The goal of the ICFA standard for superconducting wire and cable of accelerator magnets.** Hirabayashi, H. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

The ICFA panel on Superconductivity and Cryogenics is preparing a standard evaluation method for wires and cables of accelerator magnets. The standard evaluation method is simply called as 'ICFA standard'. The draft No.3 of this standard was published in 1989 to raise wide discussions and comments over the world. In this report, the expected goal of 'ICFA Standard' is discussed briefly, followed with the revised up-to-date draft No.4. (author).

22298 (KEK-PROC–92-14, pp. 97-99) **Results on testing pilot industrial batch of SC magnets for the UNK.** Ageev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Protvino (Russian Federation)); Andreev, N.I.; Balbekov, V.I. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

IHEP has developed and studied the superconducting dipoles and quadrupoles of the regular part of the UNK main ring which satisfy the requirements imposed on them. The pilot-industrial batch of the UNK SC magnets is produced now. The reproducibility of the magnet characteristics is studied and the mass production technology is optimized with this batch. The paper presents the results on the cryogenic tests and the magnetic field measurements for the UNK SC dipoles of the pilot-industrial batch. (author).

22299 (KEK-PROC–92-14, pp. 100-108) **Recent status of superconductors for accelerator magnets.** Greene, A.F. (Brookhaven National Lab., Upton, NY (United States)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

A survey is given of superconductor wire and cable which has been or will be used for construction of dipole magnets for all of the large European and U.S. superconducting accelerator rings. Included is a simplified view of the construction methods and operating requirements of an accelerator dipole magnet, with emphasis on required superconductor performance. The methods of fabricating Nb-Ti superconductors are described, including the critical parameters and materials requirements. The superconductor performance requirements are summarized in an effort to relate why these are important to accelerator designers. Some of the recently observed time dependent effects are covered briefly. (author).

22300 (KEK-PROC–92-14, pp. 119-137) **Recent status of superconducting accelerator cavities.** Padamsee, H. (Cornell Univ., Ithaca, NY (United States). Lab. of Nuclear Studies). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

RF Superconductivity has become an important technology for particle accelerators for high energy physics, nuclear physics and free electron lasers. More than 100 MVolts of Superconducting RF (SRF) cavities have been installed in accelerators for heavy ions and operated at gradients of 2-3 MV/m in excess of 10^5 hours. More than 500 MVolts are installed in electron accelerators and operated at gradients of 4-6 MV/m in excess of 10^4 hours. Enouraged by this success, another 500 meters of SRF cavities are in the production line, the major fraction to upgrade the energy of LEP to 100 GeV and to build CEBAF. New applications are forthcoming for a 1 GeV pion accelerator (PILAC) and for a high current e^+e^- collider in the B-quark energy range (B-factory). For the next linear collider in the TeV energy range, there are many compelling attractions to use SRF, if the gradients can be improved substantially and the costs lowered. Substantial progress has been made in understanding performance limitations and in inventing cures through better cavity geometries, materials and processes. Techniques are now in hand to reach 15-20 MV/m accelerating. In light of this progress, the potential of high gradient SRF for a TeV Energy Superconducting Linear Accelerator (TESLA) will be explored. (author).

22301 (KEK-PROC–92-14, pp. 138-147) **The future of surface treatment technologies for high field niobium superconducting cavities.** Saito, Kenji (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

The recent applications of superconducting cavities are directed to a TeV energy linear accelerator (TESLA) which needs the very high field gradient of > 25 MV/m and a very high current machine for B-factory which requires to accelerate the current of several amperes. On the second item, how to damp strong higher order modes which lead to beam instabilities is the main subject and the main R and D is not in cavity itself with present technologies. However, the first item requires to upgrade much more present technologies with niobium materials, cavity fabrication and preparations. This paper concentrates our interests on the first item and reports on efforts to improve cavity performances. As technologies for high field, discussions will be focused on surface treatments like chemical polishing, electropolishing, anodizing, high pressure water rinsing and ultra high vacuum annealing. The acceleration field gradient is often limited to 10-20 MV/m in L-band niobium cavities by conventional wet surface preparations. These limitations are due to field emission and two sides multipacting. Especially multipacting is a serious problem. At first concerning to multipacting, the field limitation of TRISTAN sc is reconsidered. It is presented that two sides first order multipacting level exists at 7 MV/m for KEK shape and it corresponds to 20 MV/m for L-band cavities by frequency dependence of multipacting. If the two sides multipacting is suppressed by cavity geometry, attainment of the field gradient of 25 MV/m in L-band cavities by conventional wet treatments will be no problem. (author).

22302 (KEK-PROC–92-14, pp. 156-159) **Recommendations of standard tests and tolerances for accelerator magnet cables.** Scanlan, R.M. (Lawrence Berkeley Lab., CA (United States)); Royet, J.M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

The designs for present and next generation accelerator magnets are placing more stringent requirements on the superconducting wire and cables. In particular, the cables have more strands and are wider than those used in the Tevatron and HERA, and those requirements have stimulated cable tooling changes. Also, the dimensional tolerance requirements for the SSC have led to the development of new methods for measuring cable dimensions and additional controls in the cabling operations. The requirement for millions of meters of cable is also stimulating the development of new techniques for on-line quality assurance methods for the SSC cables. We will report on the status of these developments at LBL and also discuss the relevance of this work to the efforts at developing international standards. (author).

22303 (KEK-PROC–92-15, pp. 490-492) **Human-machine interface software package.** Liu, D.K. (Academia Sinica, Beijing, BJ (China). Inst. of High Energy Physics); Zhang, C.Z. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The Man-Machine Interface software Package (MMISP) is designed to configure the console software of PLS 60 Mev LINAC control system. The control system of PLS 60 Mev LINAC is a distributed control system which includes the main computer (Intel 310) four local station, and two sets of industrial level console computer. The MMISP provides the operator with the display page editor, various I/O configuration such as digital signals In/Out, analog signal In/Out, waveform TV graphic display, and interactive with

operator through graphic picture display, voice explanation, and touch panel. This paper describes its function and application. (author).

22304 (KEK-PROC–92-15, pp. 493-495) **Correlation Plot facility in the SLC control system.** Hendrickson, L. (Stanford Linear Accelerator Center, CA (United States)); Phinney, N.; Sachez-Chopitea, L.; Clark, S. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The Correlation Plot facility is a powerful interactive tool for data acquisition and analysis throughout the SLC. This generalized interface allows the user to perform a range of operations or machine physics experiments without the need for any specialized analysis software. The user may step one or more independent parameters, such as magnet or feedback set points, while measuring or calculating up to 160 other parameters. Measured variables include all analog signals available to the control system, as well as calculated parameters such as beam size, luminosity, or emittance. Various fitting algorithms and display options are provided. A software-callable interface has been provided so that a host of applications can call this package for analysis and display. Such applications regularly phase klystrons, measure emittance and dispersion, minimize beam size, and maintain beam collisions at the interaction point. (author).

22305 (KEK-PROC–92-15, pp. 496-499) **Iconic representation of particle beams using personal computers.** Dasgupta, S. (Variable Energy Cyclotron Centre, Calcutta (India)); Sarkar, D.; Mallik, C. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The idea of representing the character of a charged particle beam by means of its emittance ellipses, is essentially a mathematical one. For quick understanding of the beam character in a more user-friendly way, unit beam cells with particles having a uniform nature, have been pictured by suitably shaped 3-D solids. The X and Y direction momenta at particular cell areas of the particle beam combine together to give a proportionate orientation to the solid in the pseudo 3-D world of the graphic screen, creating a physical picture of the particle beam. This is expected to facilitate the comprehension of total characteristics of a beam in cases of online control of transport lines and their designs, when interfaced with various ray-tracing programs. The implementation is done in an IBM-PC environment. (author).

22306 (KEK-PROC–92-15, pp. 500-504) **Object-oriented programming techniques for the AGS Booster.** Skelly, J.F. (Brookhaven National Lab., Upton, NY (United States). Alternating Gradient Synchrotron Dept.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The applications software developed for the control system of the AGS Booster Project was written in the object-oriented language, C++. At the start of the Booster Project, the programming staff of the AGS Controls Section comprised some dozen programmer/analysts, all highly fluent in C but novices in C++. During the course of this project, nearly the entire staff converted to using C++ for a large fraction of their assignments. Over 100 C++ software modules are now available both for Booster and general AGS use, of which a large fraction are broadly applicable tools. The transition from C to C++ from a managerial perspective is discussed and an overview is provided of the ways in which object classes have been applied in Booster software development. (author).

22307 (KEK-PROC–92-15, pp. 505-510) **A simplified approach to control system specification and design using domain modelling and mapping.** Ludgate, G.A. (TRIUMF, Vancouver, BC (Canada)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Recent developments in the field of accelerator-domain and computer-domain modelling have led to a better understanding of the 'art' of control system specification and design. It now appears possible to 'compile' a control system specification to produce the architectural design. The information required by the 'compiler' is discussed and one hardware optimization algorithm presented. The desired characteristics of the hardware and software components of a distributed control system architecture are discussed and the shortcomings of some commercial products. (author).

22308 (KEK-PROC–92-15, pp. 511-513) **The direct manipulation shell: Creating extensible display page editors.** Allen, M.E. (Superconducting Super Collider Lab., Dallas, TX (United States)); Christiansen, M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Accelerator controls systems provide parameter display pages which allow the operator to monitor and manipulate selected control points in the system. Display pages are generally implemented as either hand-crafted, purpose-built programs; or by using a specialized display page layout tool. These two methods of display page development exhibit the classic trade-off between functionality vs. ease of implementation. In the Direct Manipulation Shell we approach the process of developing a display page in a manifestly object-oriented manner. This is done by providing a general framework for interactively instantiating and manipulating display objects. (author).

22309 (KEK-PROC–92-15, pp. 514-519) **Object oriented programming techniques applied to device access and control.** Goetz, A. (European Synchrotron Radiation Facility, 38 - Grenoble (France)); Klotz, W.D.; Meyer, J. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

In this paper a model, called the device server model, has been presented for solving the problem of device access and control faced by all control systems. Object Oriented Programming techniques were used to achieve a powerful yet flexible solution. The model provides a solution to the problem which hides device dependancies. It defines a software framework which has to be respected by implementors of device classes - this is very useful for developing groupware. The decision to implement remote access in the root class means that device servers can be easily integrated in a distributed control system. A lot of the advantages and features of the device server model are due to the adoption of OOP techniques. The main conclusion that can be drawn from this paper is that 1. the device access and control problem is adapted to being solved with OOP techniques, 2. OOP techniques offer a distinct advantage over traditional programming techniques for solving the device access problem. (J.P.N.).

22310 (KEK-PROC–92-15, pp. 520-523) **An object-oriented implementation of the TRIUMF 92 MHz booster cavity control system.** Wilkinson, N.A. (TRIUMF, Vancouver, BC (Canada)); Ludgate, G.A. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics

control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

A 92 MHz auxiliary accelerating cavity has been designed for installation inside the TRIUMF cyclotron, operating up to a maximum peak voltage of 200 kV. The cavity doubles the energy gain per turn for accelerating hydrogen ions in the energy region of 400-500 MeV, and reduces by 50% the stripping loss of the ion beam. The control system for the booster comprises a PC-based processor in a VME crate, for local control, and a 68030 processor with an ethernet connection as the interface to the TRIUMF Central Control System. The requirements for the booster control system were established by an object-oriented requirements analysis. Afterward, an object-oriented architectural design step was used to produce the processor allocation of the design, which was then implemented using C, for the VME processor, and a commercial database and screen generator product, for the VAX user interface. (author).

22311 (KEK-PROC–92-15, pp. 524-527) **The state manager: A tool to control large data-acquisition systems.** Defendini, A. (European Organizaion for Nuclear Research, Geneva (Switzerland)); Jones, R.; Matheys, J.P.; Vyvre, P.V.; Vascotto, A. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The State Manager system (SM) is a set of tools, developed at CERN, for the control of large data-acquisition systems. A dedicated object-based language is used to describe the various components of the data-acquisition system. Each component is declared in terms of finite state machines and sequences of parametrized actions to be performed for operations such as the start and end of a run. The description, written by the user, is translated into Ada to produce a run-control program capable of controlling processes in a distributed environment. A Motif-based graphical interface to the control program displays the current state of all the components and can be used to control the overall data-acquisition system. The SM has been used by several experiments both at CERN and other organizations. We present here the architecture of the SM, some design choices, and the experience acquired from its use. (author).

22312 (KEK-PROC–92-15, pp. 528-534) **CASE in CERN's accelerator sector.** Albrecht, A. (European Oraganization for Nuclear Research, Geneva (Switzerland)); Cabas-Alonso, A.; Chevrier, F. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

As in the software industry where computer aided software engineering (CASE) methodologies and tools are commonly used, CERN endeavours to introduce this technology to improve the efficiency of designing, producing and maintaining software. A large project is currently under development in the administrative area whereas a dedicated group had been set up to evaluate state of the art techniques for software development relating to physics experiments. A similar activity, though on a smaller scale, has been initiated in the accelerator sector also in view of the large amount of software that will be required by the LEP200 and the LHC projects. This paper briefly describes this technology and gives an account of current experience with the use of CASE methods and tools for technical projects in the accelerator sector at CERN. (author).

22313 (KEK-PROC–92-15, pp. 538-541) **SSC lattice database and graphical interface.** Trahern, C.G. (Superconduction Super Collider Lab., Dallas, TX (United States)); Zhou, J. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

The SSC lattice database and the graphical tools used to access it are discussed. (author).

22314 (KEK-PROC–92-15, pp. 542-545) **Framework for control system development.** Cork, C. (Lawrence Berkeley Lab., CA (United States)); Nishimura, Hiroshi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Control systems being developed for the present generation of accelerators will need to adapt to changing machine and operating state conditions. Such systems must also be capable of evolving over the life of the accelerator operation. In this paper we present a framework for the development of adaptive control systems.

22315 (KEK-PROC–92-15, pp. 546-549) **The LEP model interface for MAD.** Iselin, F.C. (European Organization for Nuclear Research, Geneva (Switzerland)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

During machine studies and trouble-shooting in the LEP machine various optical parameters must be computed, which can be found quickly using the MAD program. However, the LEP operators are not all well acquainted with MAD. In order to ease their task, a simple interface called the LEP model has been written to run on the Apollo workstations of the LEP control system. It prepares jobs for MAD, sends them to a DN 10000 node for execution, and optionally plots the results. The desired machine positions and optical parameters vary between LEP runs. The LEP model contains a powerful selection algorithm which permits easy reference to any combination of positions and optical parameters in the machine. Elements can be chosen by name, by sequence number, or by element class. The choice of optical functions includes closed orbit, Twiss parameters, betatron phases, chromatic functions, element excitations, and many more. Recently matching features have been added. Communication with the control system and with MAD uses self-describing tables, i.e. tables whose columns are labelled with their name and a format code. Experience with this LEP model interface is reported. (author).

22316 (KEK-PROC–92-15, pp. 550-554) **Optimization of accelerator control.** Vasiljev, N.D. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (Russian Federation)); Mozin, I.V.; Shelekhov, V.A.; Efremov, D.V. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Expensive exploitation of charged particle accelerators is inevitably concerned with requirements of effectively obtaining of the best characteristics of accelerated beams for physical experiments. One of these characteristics is intensity. Increase of intensity is hindered by a number of effects, concerned with the influence of the volume charge field on a particle motion dynamics in accelerator's chamber. However, ultimate intensity, determined by a volume charge, is almost not achieved for the most of the operating accelerators. This fact is caused by losses of particles during injection, at the initial stage of acceleration and during extraction. These losses are caused by deviations the optimal from real characteristics of the accelerating and magnetic system. This is due to a number of circumstances, including technological tolerances on structural elements of systems, influence of measuring and auxiliary equipment and beam consumers' installations, placed in the

closed proximity to magnets, and instability in operation of technological systems of accelerator. Control task consists in compensation of deviations of characteristics of magnetic and electric fields by optimal selection of control actions. As for technical means, automatization of modern accelerators allows to solve optimal control problems in real time. Therefore, the report is devoted to optimal control methods and experimental results. (J.P.N.).

22317 (KEK-PROC–92-15, pp. 579-582) **Frequency domain analyses of Schottky signals using a VME based data server and a workstation client.** Chapman-Hatchett, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Chohan, V.; Deloose, I.; Pedersen, F. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Schottky signals are extensively used for observation, setting-up and operation of CERN's Antiproton rings, namely the AC, the AA and LEAR. Measurement of these signals is, at present, carried out by a series of commercial instruments. These instruments have to be individually controlled and read by each application program. The operational use of the system is limited by the capabilities of the individual instruments. The first objective for the new system was to provide, as far as possible, a true 'server'. The 'client' application program simply requests the data it requires. It is then supplied with measured and processed data. This provides the operator with a fast response by having ready processed data always available. Our second goal was to make the system operationally simple, with multiple windows and presentation on a single screen. This paper discusses some aspects of this implementation and applications for the antiproton production, collection, and storage rings. (author).

22318 (KEK-PROC–92-15, pp. 583-586) **New controls for the CERN-PS hadron injection process using operating tools and high-level accelerator modelling programmes.** Arruat, M. (European Organization for Nuclear Research, Geneva (Switzerland)); Boutheon, M.; Cons, L. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

A new control system using man-machine interface tools with workstations as consoles has been successfully put into operation for the injection of hadrons in the CERN Proton Synchrotron (PS). This paper mainly focuses on specialized modelling programmes involving complex treatments for an optimum operation of the injection process. These programmes include the control of the injection timings, the measurement of the beam emittance with an estimation of how well the incoming beam is matched, and the correction of oscillations at injection. The infrastructure and the programming environment underlaying the new control system are described elsewhere. The outstanding feature of the internal structure of all these modelling programmes is that they carry out three kinds of data interaction: the input, that is the measurements (e.g. beam time positions, profiles and trajectories), the physical parameters (e.g. required times for synchronization, beam emittance, beam space position and angle at injection), and the output, mainly the hardware values (e.g. preset counter settings, currents to apply to injection steering magnets). (author).

22319 (KEK-PROC–92-15, pp. 587-590) **CARSO - a program for automated first turn steering.** Plesko, M. (Sincrotrone Trieste (Italy)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

CARSO is a program package which contains several new software tools to be used during first turn steering of a storage rings, or during the steering through a beam transfer line. CARSO includes routines which check the effects of magnetic components on the beam, check the measurements of the beam position monitors and simultaneously steer the beam through the ring to perform one full turn. The programs are written in ANSI extended standard FORTRAN 77 and comprise 6000 lines of source code, 87 subroutines and about 1000 different variables. The concepts used within CARSO are presented. (author).

22320 (KEK-PROC–92-15, pp. 591-594) **Control protocol: the proposed new CERN standard access procedure to accelerator equipment: Status report.** Baribaud, G. (European Organization for Nuclear Research, Geneva (Switzerland)); Barnett, I.; Benincasa, G. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-911116–: ICALEPCS '91: International conference on accelerator and large experimental physics control systems, Tsukuba (Japan), 11-15 Nov 1991). In *Proceedings of international conference on accelerators and large experimental physics control systems.* 658p. Order Number DE94727632. Source: OSTI; NTIS; INIS.

Control protocol provides a normalized access procedure for equipment of the same kind from a control system. Modelisation and the subsequent identification of functionalities with their parameters, variables and attributes have now been carried out at CERN for representative families of devices. ISO specifications, such as the ASN.1 metalanguage for data structure representation and MMS definitions and services have, to some extent, been introduced in the design for generality and compatibility with external world. The final product of this design is totally independent of the control systems and permits object oriented implementations in any controls frame. The present paper describes the different phases of the project with a short overview of the various implementations under development at CERN. (author).

22321 (LBL–34749) **Third-generation synchrotron light sources.** Schlachter, A.S. (Lawrence Berkeley Lab., CA (United States)); Wuilleumier, F.J. Lawrence Berkeley Lab., CA (United States). Sep 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9206445–3: NATO Advanced Study Institute workshop, Maratea (Italy), 28 Jun - 10 jul 1992). Order Number DE94011375. Source: OSTI; NTIS; INIS; GPO Dep.

X rays are a powerful probe of matter because they interact with electrons in atoms, molecules, and solids. They are commonly produced by relativistic electrons or positrons stored in a synchrotron. Recent advances in technology are leading to the development of a new third generation of synchrotron radiation sources that produce vacuum-ultraviolet and x-ray beams of unprecedented brightness. These new sources are characterized by a very low electron-beam emittance and by long straight sections to accommodate permanent-magnet undulators and wigglers. Several new low-energy light sources, including the Advanced Light Source, presently under construction at the Lawrence Berkeley Laboratory, and ELETTRA, presently being constructed in Trieste, will deliver the world's brightest synchrotron radiation in the VUV and soft x-ray regions of the spectrum. Applications include atomic and molecular physics and chemistry, surface and materials science, microscopy, and life sciences.

22322 (SAND–93-1969C) **Intense electron-beam transport in the ion-focused regime through the collision-dominated regime.** Sanford, T.W.L. (Sandia National Labs., Albuquerque, NM (United States)); Poukey, J.W.; Welch, D.R.; Mock, R.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-940634–3: 10. international conference on high power particle beams, San Diego, CA (United States), 20-24 Jun 1994). Order Number DE94013826. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reviews the transport of the 19-MeV, 700-kA, 25-ns Hermes-III electron beam in long gas cells filled with N_2 gas spanning six decades in pressure from 10^3 to $\sim 10^3$ Torr. We show through measurements and theoretical analyses that the beam has two windows of stable transport: a low-pressure window (between

~1 and ~100 mTorr) that is dominated by propagation in the semi-collisionless IFR (ion-focused regime), and a high-pressure window (between ~1 and ~100 Torr) that is dominated by propagation in the resistive CDR (collision-dominated regime). In the CDR, 79±1.5% of the beam energy is transported over 11 m at 20 Torr. In the IFR, we show that intense radiation fields with controllable rise times and pulse widths can be generated on axis at a bremsstrahlung target. In summary, the measurements and analyses presented here provide a quantitative description of the Hermes-III beam transport over six decades in pressure.

22323 (SAND–93-2183) **In situ evaporation of lithium for LEVIS ion source.** Gerber, B.; Lopez, M.; Lamppa, K.; Stearns, W.; Bieg, K. Sandia National Labs., Albuquerque, NM (United States). May 1994. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013455. Source: OSTI; NTIS; GPO Dep.

This report describes the In Situ evaporation of pure lithium on the anode of PBFA II which then can be evaporated and ionized by Laser Evaporation and Ionization Source (LEVIS). Included in this report are the necessary calculations, light laboratory experiments and details of the hardware for PBFA II. This report gives all the details of In Situ evaporation for PBFA II so when a decision is made to provide an active lithium source for PBFA II, it can be fielded in a minimum of time.

22324 (SLAC-PUB–6498) **Developments in electron gun simulation.** Herrmannsfeldt, W.B. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9406180–1: 6. international symposium on electron beam ion sources and their applications, Stockholm (Sweden), 20-23 Jun 1994). Order Number DE94013356. Source: OSTI; NTIS; INIS; GPO Dep.

This paper will discuss the developments in the electron gun simulation programs that are based on EGUN and its derivatives and supporting programs. Much of the code development has been inspired by technology changes in computer hardware; the implications on EGN2 of this evolution will be discussed. Some examples and a review of the capabilities of the EGUN family will be described.

22325 (SSCL-SR–1225, pp. 637-638) **Summary of the machine detector interface working group.** White, S. (Brookhaven National Laboratory, Upton, NY (United States)); Bharadwaj, V. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The Machine Detector Interface working group met to consider the accelerator and beamline issues as they impact the various B physics experimental options. The options may be divided into fixed target type and colliding beam type experiments. The fixed target experiments use both extracted beams and internal targets in storage rings. For the colliding option, apart from using existing and planned accelerators (e.g., Tevatron and SSC) the working group spent some time looking at the concept of asymetric hadron colliders. The latter may offer some kinematical advantages and their novel nature make them look advantageous.

22326 (SSCL-SR–1225, pp. 639-640) **Fixed and internal target options: Parameters and impact.** Murphy, C.T. (Fermilab, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This paper collects the experimental and accelerator parameters of the various fixed target and internal target B-physics proposals. The Hera-B experiment targets protons on fine wires in the halo of the circulating beam. The GAJET experiment targets protons on a hydrogen gas jet in the circulating beam of LHC. The LHB crystal experiment extracts protons from LHC using a bent crystal and makes B's in a solid target external to the machine. The SFT (Super Fixed Target) experiment does the same thing at the SSC.

22327 (SSCL-SR–1225, pp. 641-644) **Test of an internal wire target at the HERA proton ring.** Lohse, T. (MPI fur Kernphysik, Heidelberg (Germany)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

For the HERA accelerator the first phase of test experiments using internal wire targets has led to a proof of principle of the technology, together with rather detailed understanding of the mechanisms relevant for the interaction of wire targets and beam halo. The main results are: (1) interactions of halo protons with the wire have been observed with rates up to 100 kHz; (2) the wire does not produce large beam background - it reduces the beam lifetime to typically 40 to 50 hr; (3) tracking simulations are able to quantitatively predict the observed interaction rates. Extrapolating to design parameters, the models predict rates sufficient for a major B experiment at HERA; (4) transients of rates observed directly after a wire movement resemble those expected for a semi-transparent scraper. Nonetheless, a number of problems remain. The most serious ones are the unexpected event topology, suggesting that the events are more crowded than expected, and the time structure of VETO signals, suggesting the existence of a component of more or less isotropically produced slow particles. These problems will be attacked by a more sophisticated target and detector, which have been installed for the 1993 run. The authors are confident that these test will give the final proof of the feasibility of a halo target for the planned B experiment.

22328 (SSCL-SR–1225, pp. 645-647) **Extraction from TEV-range accelerators using bent crystal channeling.** Carrigan, R.A. Jr. (Fermilab, Batavia, IL (United States)); Jackson, G.; Murphy, C.T.; Newberger, B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Plans and first results from Fermilab Experiment 853 are presented. E853 is an experiment to test the feasibility and efficiency of extracting a low-intensity beam from the halo of the Tevatron using channeling in a bent silicon crystal. The motivation of the experiment is to apply crystal extraction to trans-TeV accelerators like the SSC. Channeling developments related to crystal extraction and some early results from accelerator studies at the Tevatron are presented.

22329 (SSCL-SR–1225, pp. 649-651) **Synopsis of a design of a crystal extraction facility in the SSC east utility straight.** Dukes, E.C. (Univ. of Virginia, Charlottesville, VA (United States)); Murphy, C.T.; Parker, B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The option of extracting a small fraction of the circulating 20 TeV SSC beam has been discussed for some time. The potential uses of such a beam would be many, but in particular, the opportunities of doing B physics are very appealing and have led to an Expression of Interest (EOI-14) which discusses extracting approximately 10^8 protons/sec from the halo of the circulating beam using a bent silicon crystal. From the beginning the SSC has recognized the exciting physics potential of an extracted beam, and the SSC footprint includes a stratified fee land area and a buried beam zone access for the muon vector from an extracted beam hall. In this memo the authors consider the implementation of a crystal extraction system in the east utility straight of the SSC. They show that an extraction system can be added with only minor alterations to the collider: the addition of a three-magnet dogleg (identical to that design for the west utility straight); the addition of two dipole strings; and the addition of a 160 meter long alcove to make the

extracted beam line microtunnel to the collider tunnel. The present scheme to allow for momentum scraping in the east utility straight is not affected. The design of the alcove is similar to that of the two alcoves needed for the scraper shielding in the east utility straight. As is the case with the scraper alcoves, excavating the alcove before the tunnel is finished is cost effective and would alleviate much of the disruption and added cost involved in adding an alcove to the finished tunnel at a later data.

22330 (SSCL-SR–1225, pp. 653-655) **Design of the SSC Medium-Beta interaction regions.** Nosochkov, Y.M. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In the SSC design the 87.12 km long collider lattice consists of two 35.28 km identical arcs located on the North and South sides of the machine and two 8.28 km clusters placed on the West and on the East. Each cluster contains two Interaction Regions (IRs), the Utility section and the interconnect sections between them. According to present plans the goal for the optics in the East IRs is to provide for a high value of the luminosity and, hence, for a low β at the Interaction Point (IP). The West IRs are aimed at providing for a large space for detector which can be achieved at the cost of higher value of the β^* and lower luminosity. The optics of each IR are based on the same optical configuration which gives an opportunity to use mostly identical quadrupoles and dipoles in four IRs. Trivial modification of the central region in this basic configuration allows for a wide range of values for detector free space from $L^* = 20$ m to $L^* = 90$ m, suitable for the experiments in both clusters. L^* denotes here the distance between the IP and the nearest magnetic element of the machine. In this paper the author briefly reviews the current design of the so-called medium-β IR optics with a large free space for detector of $L^* = 90$ m, which could be used in the West cluster.

22331 (SSCL-SR–1225, pp. 657-661) **Summary of the snowmass working group on machine-detector interface.** Bharadwaj, V. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Colestock, P.; Cooper, J.; Goderre, G.; Holt, J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

From the detector point of view, what experimenters need is an outline of the EXPECTED machine parameters tempered with some indication of the POSSIBLE machine parameters. Given guidance from accelerator physicists on the machine, experimenters may get the germ of an idea of how to exploit a particular machine property. Similarly, given some indication of what is important to the experimenters, accelerator physicists may have ideas of how to modify the machine appropriately. The authors discuss a list of machine parameters from the perspective of experimentalists. These include: luminosity; number of bunches/bunch spacing; beam energy; luminosity lifetime; β^*/longitudinal emittance; transverse emittance. They also include a summary of tevatron performance - past, present, and projected.

22332 (SSCL-SR–1225, pp. 663-666) **Asymmetric collider.** Bharadwaj, V. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Colestock, P.; Goderre, G.; Johnson, D.; Martin, P.; Holt, J.; Kaplan, D. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The study of CP violation in beauty decay is one of the key challenges facing high energy physics. Much work has not yielded a definitive answer how this study might best be performed. However, one clear conclusion is that new accelerator facilities are needed. Proposals include experiments at asymmetric electron-positron colliders and in fixed-target and collider modes at LHC and SSC. Fixed-target and collider experiments at existing accelerators, while they might succeed in a first observation of the effect, will not be adequate to study it thoroughly. Giomataris has emphasized the potential of a new approach to the study of beauty CP violation: the asymmetric proton collider. Such a collider might be realized by the construction of a small storage ring intersecting an existing or soon-to-exist large synchrotron, or by arranging collisions between a large synchrotron and its injector. An experiment at such a collider can combine the advantages of fixed-target-like spectrometer geometry, facilitating triggering, particle identification and the instrumentation of a large acceptance, while the increased $\sqrt{s}$ can provide a factor > 100 increase in beauty-production cross section compared to Tevatron or HERA fixed-target. Beams crossing at a non-zero angle can provide a small interaction region, permitting a first-level decay-vertex trigger to be implemented. To achieve large $\sqrt{s}$ with a large Lorentz boost and high luminosity, the most favorable venue is the high-energy booster (HEB) at the SSC Laboratory, though the CERN SPS and Fermilab Tevatron are also worth considering.

22333 (SSCL-SR–1225, pp. 667-668) **Experimental modification of SSC interaction region.** Johnson, D.E. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The SSC Collider design has four interaction regions. Two of these regions are configured for high-luminosity collisions and have been previously described in detail. The other two regions are, as yet, uncommitted. Early Collider designs called for two medium-luminosity regions, and lattice designs very similar to those for the high-luminosity regions were developed. An updated medium-beta design was recently developed. Questions have been raised by experimental proponents as to the possibility of inserting analyzing magnets into the lattice design. This paper examines the interference of experimental magnets with the basic machine lattice.

22334 (SSCL-SR–1225, pp. 669-672) **Radiation environment and shielding at the SSC.** Diwan, M.V. (SSC Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Much higher radiation levels are expected at the SSC compared to all previous colliders because of the increased center of mass energy (40 TeV) and the increased luminosity ($10^{33}cm^{-2}s^{-1}$ for a general purpose high $P_\perp$ detector, and $10^{32}cm^{-2}s^{-1}$ for the proposed B detectors). The author performed a comprehensive study of the radiation environment for the proposed GEM detector at the SSC. As a result of this study, a shielding scenario was developed that will ensure that the detector will operate with its design performance for at least 10 years at the standard luminosity of $10^{33}cm^{-2}s^{-1}$. The main concerns of this study were: (1) the charged particle, neutron, and photon fluxes, and the hit rates generated in the inner tracker and the muon spectrometer; (2) the radiation doses delivered, especially to the inner tracker layers, the endcap and forward calorimeter components, and the beam line components within and near the experiment; (3) radioactivation of the inner and forward parts of the detector and the beam line, and levels of radioisotopes generated in the experimental hall. While much of the study was specific to the detector geometry proposed for the GEM experiment, many of the results are applicable to other SSC experiments. In particular, the general considerations of energy loss in the collision hall presented in Section 2 should be applicable to the proposed B-physics experiments. In section 3 results specific to GEM are presented, and some conclusions specific to proposed B-physics detector geometires such as BCD are drawn.

22335 (SSCL-SR–1225, pp. 673-676) **Fixed-target particle fluxes and radiation levels at SSC energies.** Dukes, E.C. (Univ. of Virginia, Charlottesville, VA (United States)). Fermi National

Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The author calculates the charged particle fluxes and radiation doses from minimum ionizing particles (MIP), electromagnetic showers, and hadronic showers, in a fixed-target experiment at the SSC. This work follows the work of Groom, essentially boosting his results into the laboratory frame. The radiation in dense matter, such as a calorimeter, is produced by several sources: electromagnetic showers, hadronic showers, and minimum ionizing particles. The author does not consider other sources of radiation such as beam halo, a dependent effects, and low energy neutrons from secondary sources. Nor does he consider the effects of magnetic fields. Low energy neutrons have been shown to be an important source of radiation for collider experiments at the SSC. In fixed-target experiments, where the spectrometer is more open and where most detector elements are far away from secondary particle dumps, these sources are not as important. They are also very much detector and experimental hall dependent. Hence the results presented here are only a lower limit of the estimated radiation dose.

22336 (SSCL-SR–1225, pp. 681-684) **Obtaining slow beam spills at the SSC collider.** Ritson, D. (Stanford Linear Accelerator Center, CA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In addition to rf noise excitation, other methods should be able to provide slow controlled beam spills onto SSC targets. The most convenient and easily controlled of such methods is to move operating tunes so as to keep the large amplitude beam halo on an edge of the "operating diamond". This positions the dynamic aperture to cause short lifetimes before loss for large amplitude particles. The target is naturally located for nominal SSC operation outside the edge of the dynamic aperture, where effective diffusion velocities are large. This ensures that spill intensities remain uniform and are minimally modulated by orbit movements from cultural and seismic disturbances. The authors believe that both rf noise emittance growth and movement of the edge of the dynamic aperture are likely to satisfactorily provide controlled beam loss and that a final choice of method may be determined by operational experience at current accelerators or with the SSC.

22337 (SSCL-SR–1225, pp. 685) **Ultra thin beam pipes for internal target experiments.** Joestlein, H. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Experiments looking for particles from B-decays at colliders, especially at large eta, find that the material presented by typical beam pipe walls (0.5 mm Be) present a significant mass causing multiple scattering. Under external pressure conditions, wall thickness is needed to resist deformation of the pipe. The pipe is unstable if the energy released by the reduction of internal volume exceeds the energy stored in the deformed pipe wall material. Both energies are proportional to the cube of the deformation. The deformation mode depends on pipe length between stabilizers, and can range from oval (basic mode) to high order "ripple type" modes. Very low mass pipes can be designed by combining a thin wall pipe with periodic ring type stiffeners. This design can be made compatible with the very low outgassing requirements by using a two step process. The thin pipe "sleeve" is made by brazing a thin Be sheet into a cylinder, and by brazing on appropriate ends. This sleeve can be vacuum baked and tested at reduced differential pressure, but not be fully evacuated. After the sleeve has been leak checked and vacuum baked, the external stiffening rings are attached using adhesives. Such structures are currently in development at the Fermilab Physics Department.

22338 (SSCL-SR–1225, pp. 687) **Point-like internal targets for B experiments.** Joestlein, H. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Fixed target geometries are being studied for B experiments. Some use internal targets in colliders, e.g. the proposal for HERA. Their current proposal uses very thin stretched wires. The wires are brought into the beam halo when the beam is stabilized. Their measurements have confirmed that sufficient luminosity and stability can be obtained without impairing collider performance for concurrent other experiments. Fixed target geometries lead to high laboratory momenta of the secondary particles, resulting in large vertex displacements. Wires constrain the primary vertex in the two dimensions transverse to the wire. The third dimension is constrained only by the beam spot size. It appears desirable to use a point like target, if possible, to constrain the event vertex in three dimensions.

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22339 (KEK-PROC–92-14, pp. 23-27) **Influence of cable eddy currents on magnetic field harmonics.** Ogitsu, T. (Superconducting Super Collider Lab., Dallas, TX (United States)); Zhao, Y.; Akhmetov, A.; Devred, A. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1992. (CONF-9206281–: ICFA workshop on AC superconductivity, Tsukuba (Japan), 23-25 Jun 1992). In *Proceedings of ICFA workshop on AC superconductivity (ACSC92).* 182p. Order Number DE94737966. Source: OSTI; NTIS; INIS.

Several SSC 5-cm-aperture, 15-m-long dipole magnet prototypes exhibit anomalous behavior of their magnetic field harmonics during current ramps at 4 A/s. The anomalies cease when the ramp is stopped and the current is held constant. The magnets also exhibit a dramatic degradation of their quench current as a function of ramp rate, as well as large AC-losses. After reviewing the AC-performance of the anomalous magnets, we develop a model of cable eddy currents, which can simulate the observed field behavior and the measured AC-losses, and which is consistent with the quench start localization of the high ramp-rate quenches. (author).

44 INSTRUMENTATION

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Refer also to citation(s) 21042, 21092, 21366, 21540, 22043, 22162, 22202, 22324, 22325, 22330, 22332, 22420, 22456, 22541, 22544, 22552, 22780, 22786, 22787, 22833, 22857, 22984, 23010, 23015, 23146

22340 (ANL/PHY/CP–82407) **Test and performance of a BGO Compton-suppression shield for GAMMASPHERE.** Carpenter, M.P. (and others); Khoo, T.L.; Ahmad, I. Argonne National Lab., IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940524–7: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94013431. Source: OSTI; NTIS; INIS; GPO Dep.

Bismuth germanate (BGO) compton-suppression shields have been constructed to surround the Ge detectors of the GAMMASPHERE array. A shield consists of six hexagonal tapered BGO elements, each coupled to two 1-inch x 1-inch photomultiplier tubes. In addition, a cylindrical BGO detector is placed behind the Ge detector to intercept the forward scattered gamma rays. One hundred ten such shields are planned for the GAMMASPHERE array. Procedures for measuring the performance of these shields have been developed. Large (70 %) Ge detectors when used with

these shields give a peak-to-total ratio of better tan 0.60. To date more than 85 shield have been tested and approved for use in GAMMASPHERE.

22341 (BNL–60154) **Trapping induced N_{eff} and electrical field transformation at different temperatures in neutron irradiated high resistivity silicon detectors.** Eremin, V.; Li, Z.; Ilijashenko, I. Brookhaven National Lab., Upton, NY (United States). Feb 1994. 25p. Sponsored by USDOE, Washington, DC (United States);National Research Council, Washington, DC (United States). DOE Contract AC02-76CH00016. Grant LI-CAST93. (CONF-9405168–1: 6. Pisa meeting on advanced detectors, Elba (Italy), 22-28 May 1994). Order Number DE94013535. Source: OSTI; NTIS; INIS; GPO Dep.

The trapping of both non-equilibrium electrons and holes by neutron induced deep levels in high resistivity silicon planar detectors have been observed. In the experiments Transient Current and Charge Techniques, with short laser light pulse excitation have been applied at temperature ranges of 77–300 k. Light pulse illumination of the front (p^+) and back (n^+) contacts of the detectors showed effective trapping and detrapping, especially for electrons. At temperatures lower than 150 k, the detrapping becomes non-efficient, and the additional negative charge of trapped electrons in the space charge region (SCR) of the detectors leads to dramatic transformations of the electric field due to the distortion of the effective space charge concentration N_{eff}. The current and charge pulses transformation data can be explained in terms of extraction of electric field to the central part of the detector from the regions near both contacts. The initial field distribution may be recovered immediately by dropping reverse bias, which injects both electrons and holes into the space charge region. In the paper, the degree of the N_{eff} distortions among various detectors irradiated by different neutron fluences are compared.

22342 (DOE/ER/10629–T2) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, 1981].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1981]. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004872. Source: OSTI; NTIS; GPO Dep.

This report describes the design of a magnetic spectrometer facility to be built in the Tagged Photon Lab. The design has been developed by a collaboration of physicists from Fermilab, The University of California at Santa Barbara, The University of Colorado and The University of Toronto. This group was formed to build the facility and to carry out the experiment described in Proposal 516, which is a study of photoproduced states (including charm and hidden charm) with a forward mass > 2.5 GeV. Although the design of the facility is developed from that outlined in P-516, much thought has gone into making the facility versatile enough to be used for a continuing program of physics by different groups. In addition to the 100 GeV photon physics of P-516, this facility is designed to be useful for experiments like the following: pion production experiments, hadron jet experiments, $\geq$ 300 GeV and very high intensity photon physics with the energy doubler including searches for and studies of heavy leptons. The report goes into a detailed description of the various detectors which will be part of this detector system, and the experimental equipment which will be built. Sections of this report give detailed information concerning: muon counters; analysis of Monte Carlo charmed pair events; forward proton trigger; precision time-of-flight; and a modular trigger processing system for high energy physics experiments.

22343 (DOE/ER/10629–T3) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, April 1, 1982–March 31, 1983].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1983]. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004873. Source: OSTI; NTIS; GPO Dep.

This progress report describes several projects that U of Oklahoma has participated in. The first is a muon background calculation from decay of charged pions and kaons, using ISR data at center of mass energies of 31 and 53 GeV. These calculations were compared with a number of different events. A copy of an agreement between Fermi National Accelerator Laboratory and participants in experiment E-653 is enclosed. This experiment tags charm and beauty particles by observing their decay lengths. The agreement sets out the items which need to be done in order to properly execute this experiment. A program to construct and test prototype silicon stripe detectors is also described. Preliminary detectors are in hand for testing, some are installed for actual beams for testing, and on the basis of these results the group expects to specify the design for a new system. The goals at present are to check charge collection, to check track point resolution, and to check vertex reconstruction resolution. A copy of a letter of intent to submit a proposal to LEP is included. The group proposes to submit a proposal to build an experiment with approximately 1% momentum resolution at 50 GeV/c for identifying photons, electrons, and muons. This proposal would aim at scalar particles, where accurate measures of small branching ratio decays are important. Some preliminary results from Monte Carlo simulation and data analysis of experiment E-516 are presented. In addition one group participant was involved in a CLEO experiment, which is an ongoing extension of work on a shower detector system. At present OU has the offline CLEO analysis software running and is supporting an effort with Rutgers to completer the inclusive electron measurements in the $\gamma(4S)$ resonance region. This involves proper operation of the shower detector, and development of analysis software.

22344 (DOE/ER/10629–T5) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, March 31, 1984–April 1, 1985].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1985]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004875. Source: OSTI; NTIS; GPO Dep.

This progress report describes U of Oklahoma participation in a number of detector development efforts. The first is a beam solid state device which was performance tested in runs during June and July, 1984. This was a partially instrumented test of an array of gridded solid state detectors. A beam drift chamber was also performance tested. This consist of 18 planes of 2 cells each. Each cell has drift distance of 18 mm on each side of the sense wire. Preliminary tests were also performed on a time-of-flight counter system. The system was not totally instrumented but resolution was able to be measured for its central section at least. Tests showed a number of drifts which can be monitored and corrected. Test results were also collected for the hadron calorimeter for experiment E-653 at Fermilab.

22345 (DOE/ER/10629–T6) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, April 1, 1986–March 31, 1987].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1987]. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004876. Source: OSTI; NTIS; GPO Dep.

This progress report presents information on a number of different projects worked on during the reporting period. One project is the design and performance of a multiplicity jump trigger. The prototype consist of an upstream interaction veto detector, a 3/16 inch long graphite target, a pair of before multiplicity detectors, a 1 inch decay region, and finally six after multiplicity detectors. All detectors were 300 micron thick silicon wafers with a 14 mm square active area. A tritium proportional chamber was built to check Simpson's result regarding evidence for a 17 keV massive neutrino seen in tritium decay. An electrostatic beta spectrograph has been constructed over the past five years. This detector will use hemispherical electrostatic fields to decelerate electrons from tritium beta decay. Integral endpoint spectra will be measured. The objective is to measure the electron antineutrino mass. A wide ranging theoretical program on non-perturbative quantum field theory work has been ongoing. The calculations which are being worked on involve both the electroweak and the strong interactions. In addition research work on a beam drift chamber, beam solid state detectors, and time-of-flight system are reviewed. A resistive plastic, proportional tube, gas hadron calorimeter with pad readout is described. Also the U of Oklahoma's High Energy Physics group has

constructed, tested, and now is operating two SLAC 3081/E emulators, interfaced to a micro-Vax-2. Performance data from this system is described.

22346 (DOE/ER/10629–T7) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, April 1, 1987–March 31, 1988].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1988]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004877. Source: OSTI; NTIS; GPO Dep.

This progress report describes work ongoing at U of Oklahoma aimed at the development and utilization of double-sided solid state detectors. The devices are basically 300 μm thick silicon detectors, operated in a highly depleted mode. A particle passing through deposits approximately 90 keV of energy. This signal is read out from electrodes on one face. The authors are developing devices with readouts on both faces, which should allow better spatial resolution in multistripe detectors. If signal to noise ratios can be kept high, and noise levels made low enough, for detector preamplifier systems, then such detectors may be part of a B $\bar{B}$ collider proposal. Results are included on signal correlations from a 'micron' double-sided mini-stripe detector.

22347 (DOE/ER/10629–T8) **[Hadroproduction of charmed and bottom mesons (Fermilab experiment E-653): Progress report, March 31, 1988–April 1, 1989].** Oklahoma Univ., Norman, OK (United States). Dept. of Physics and Astronomy. [1989]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-80ER10629. Order Number DE94004878. Source: OSTI; NTIS; GPO Dep.

Two double-sided multistripe silicon detectors purchased from Micron Semiconductor, Ltd. have been bench tested. The devices are 40 mm x 40 mm x 300 μm thick, with 40 stripes on each side, in directions orthogonal to each other. Interstripe resistances of 250 $\pm$ 100 kΩ were measured on the non-diode (ohmic) side when the detectors were fully depleted. A Sr^{90} source and charge sensitive amplifiers were used to measure charge correlations between orthogonal stripes on opposite sides of the detectors as a function of bias voltage. At a full depletion voltage of 42 V, the difference in pulse heights from opposite-side stripes gave a Gaussian distribution consistent with the amplifier noise, indicating that the detectors work well as two dimensional position sensitive devices.

22348 (DOE/FTR–94009396) **Assess progress being made for the KTeV electromagnetic calorimeter crystal order in France: Foreign trip report, August 6–11, 1993.** Childress, S.R. Fermi National Accelerator Lab., Batavia, IL (United States). 27 Aug 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94009396. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains a record of our activities at the Quartz & Silice facility during this visit. Significant progress was achieved in illustrating the importance and practical application of particular measurements in characterizing crystal quality, and in understanding problems with crystal polishing techniques currently being used. Detailed discussions with Quartz & Silice personnel on these issues were held, as were discussions on current production and furnace growth cycle options which may significantly increase ingot production rates.

22349 (DOE/FTR–94009398) **The IV International Conference on Calorimetry in High Energy Physics, and visit LEP detectors and the European CP-Violation experiment at CERN: Foreign trip report, September 19–October 1, 1993.** White, H.B. Jr. Fermi National Accelerator Lab., Batavia, IL (United States). 6 Jan 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94009398. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The scientific program for the Elba conference was aimed at outlining the state of the art in all aspects of calorimetry applied to high energy physics. A number of lectures were presented at the Elba conference covering the general topics of calorimetry for large experiments, sampling and precision calorimetry, calorimetry with crystals, computer simulations, electronics and radiation damage of scintillating fibers and materials. There were also reports on the expected performance of particular types of calorimeters in ongoing and future experiments. The Central European Laboratory for Particle Physics Research (CERN) has been engaged in colliding beams, as well as fixed target experiments for a number of years. Some of the exceptional results from the LEP detectors is a testament to the efficient planning and details necessary for today's larger and more complex detectors. Preparation for the next run with these detectors and tests of new fixed target detectors were observed during this visit. In addition, I discussed plans for the operation and use of the CERN (SPS) test beams during the CY1994.

22350 (ENEA-RT-AMB–92-13) **Field parameters and operational quantities for the ICRU sphere with reference photon beams: Part 2: Monte Carlo calculations of backscattered spectra and backscattered mean energy angular distribution.** Gualdrini, G.F. (ENEA, Bologna (Italy). Area Energia Ambiente e Salute); Padoani, F.; Morelli, B. ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Sep 1993. 31p. (RT/AMB–92-13). Order Number DE94775296. Source: OSTI; NTIS (US Sales Only).

Within the framework of both metrological and dosimetry research activities carried out by ENEA (Italian Agency for Energy, New Technologies and the Environment) in cooperation with other European Institutes, Monte Carlo methodologies are playing an increasingly important role. This paper is the second part of a series of technical reports summarizing the various analyses carried out using Monte Carlo computational methods for the characterization of reference photon radiation fields for the calibration of personal dosimeters. An extensive computational study was carried out in order to determine the fluence spectrum, as well as, the backscattered mean energy angular distribution versus the radiation incident angle for various X-ray reference series as proposed by ISO (International Standards Organization) and B.I.P.M. (Bureau International de Poids et Measures). The calculated parameters can be employed for the design of personal dosimeters, in order to optimize their energy and angular response.

22351 (FNAL/C–94/022) **Evaluation of candidate photomultiplier tubes for the upgrade of the CDF end plug calorimeter.** Koska, W. (Fermi National Accelerator Lab., Batavia, IL (United States)); Delchamps, S.W.; Freeman, J.; Kinney, W.; Lewis, D.; Limon, P.; Strait, J.; Fiori, I.; Gallinaro, M.; Shen, Q. Fermi National Accelerator Lab., Batavia, IL (United States). Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9310261–8: SCIFI 93: workshop on scintillating fiber detectors, South Bend, IN (United States), 24-28 Oct 1993). Order Number DE94013150. Source: OSTI; NTIS; INIS; GPO Dep.

The Collider Detector at Fermilab is upgrading its end plug calorimeter from a gas detector system to one using scintillating tiles and wavelength shifting fibers. This tile-fiber calorimeter will be read out through 1,824 photomultiplier tubes. The performance requirements of the calorimeter require that the PMTs have good response to light in the 500 nm region, provide adequate amplification for signals from minimum ionizing particles yet provide linear response for peak anode currents up to 25 mA at a gain of 50,000, and fit into the restricted space at the rear of the plugs. This paper will describe the evaluation process used to determine the adequacy of the commercially available PMTs which appeared to meet these performance requirements.

22352 (FNAL/C–94/096) **Radiation effects in polymers for plastic scintillation detectors.** Pla-Dalmau, A. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bross, A.D.; Hurlbut, C.R.; Moser, S.W. Fermi National Accelerator Lab., Batavia, IL (United States). 20 Apr 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940813–5: 208. American Chemical Society national meeting, Washington, DC (United States), 21-26 Aug 1994). Order Number DE94011748. Source: OSTI; NTIS; INIS; GPO Dep.

Radiation damage studies were performed on polystyrene and poly(vinyltoluene) samples containing different concentrations of either an antioxidant (A O-2) or a plasticizer (PP-4). In addition, parallel studies were carried out utilizing samples of these polymers prepared in the presence of cross-linking agents such as NPG, HDA, and DVB. The samples were irradiated using a ^{60} Co

source to total doses of 1 and 10 Mrad, at a dose rate of approximately 1 Mrad/h. Transmittance measurements were recorded before and immediately after irradiation, and after oxygen annealing. These experiments showed that none of these agents improved the radiation resistance of polystyrene and poly(vinyltoluene) with regard to their optical properties.

22353 (FNAL/C–94/100) **Fluorescent compounds for plastic scintillation applications.** Pla-Dalmau, A.; Bross, A.D. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940411–25: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 4-8 Apr 1994). Order Number DE94013235. Source: OSTI; NTIS; INIS; GPO Dep.

Several 2-(2′-hydroxyphenyl)benzothiazole, -benzoxazole, and -benzimidazole derivatives have been prepared. Transmittance, fluorescence, light yield, and decay time characteristics of these compounds have been studied in a polystyrene matrix and evaluated for use in plastic scintillation detectors. Radiation damage studies utilizing a ^{60}C source have also been performed.

22354 (FNAL/C–94/103) **Fermilab's DART DA system.** Pordes, R. (and others); Anderson, J.; Berg, D.; Black, D.; Forster, R.; Franzen, J.; Kent, S.; Kwarciany, R.; Meadows, J.; Moore, C. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–3: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013240. Source: OSTI; NTIS; INIS; GPO Dep.

DART is the new data acquisition system designed and implemented for six Fermilab experiments by the Fermilab Computing Division and the experiments themselves. The complexity of the experiments varies greatly. Their data taking throughput and event filtering requirements range from a few (2-5) to tens (80) of CAMAC, FASTBUS and home built front end crates; from a few 100 KByte/sec to 160 MByte/sec front end data collection rates; and from 0-3000 Mips of level 3 processing. The authors report on the architecture and implementation of DART to this date, and the hardware and software components that are being developed and supported.

22355 (INIS-BR–3314) **Annealing effects on the charged particles registration characteristic of the CR-39 traces solid detector.** Correa, M.M. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). Oct 1989. 102p. (In Portuguese). Order Number DE94626407. Source: OSTI; NTIS (US Sales Only); INIS.

CR-39 trace solid detectors samples, previously exposed to alpha particles and fission fragments from a Cf-252 source, were submitted to a annealing treatment to study his effects on the characteristics of charged particle traces registration. (L.C.J.A.).

22356 (INIS-BR–3318) **Substitution of photomultiplier tubes by photodiodes.** Teixeira, D.L. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Posgraduacao de Engenharia. Apr 1990. 63p. (In Portuguese). Order Number DE94626419. Source: OSTI; NTIS (US Sales Only); INIS.

The application of Si semiconductors, either of the conventional or the avalanche type, as light amplifiers in radiation detection, has been studied aiming the substitution of photomultiplier (PM) tubes by photodiodes. The objective of this work is to compare the response of photodiodes and PM tubes when coupled to scintillation crystals. A Hamamatsu Si photodiode, model S 1337-66 B Q, was coupled to a Harshaw NaI (Tl) scintillation crystal of window diameter equal to 25,4 mm. Its performance was evaluated by specially designed associated electronics, compatible with the photodiode characteristics. X-ray beams from 30 to 111 KeV were used to determine the response and the repeatability of the scintillator-photodiode and the scintillator-PM tube systems. The repeatability was found to be within 0,27% for the photodiode and 0,57% for the PM tube. This work confirmed that photodiodes can be used as light amplifiers, provided their characteristics, such as light spectrum response, are considered. It also shows that further studies are necessary in order to identify the applications in radiation detection where PM tubes might be replaced by photodiodes. (author).

22357 (INIS-BR–3323) **Development of a calibration system for surface radioactive contamination monitors.** Dias, S.K. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. Jul 1991. 142p. (In Portuguese). Order Number DE94626464. Source: OSTI; NTIS (US Sales Only); INIS.

A system for alpha and beta radiation detection was initially designed and constructed, using a plastic scintillator, aiming at controlling the emission rate of the standard secondary sources used for the calibration of surface contamination monitors. Its main characteristics were determined for three different electronic systems (using two electrometers and a timer-counter), applying the tests of repeatability and medium term stability, linearity response and energy dependence. The calibration factors for alpha (^{241} Am) and beta (^{90} Sr + ^{90} γ) radiation were obtained. The study was performed using two plastic scintillators with different thickness (1 e 3 mm), and it was verified that the thinnest one was the most suitable. The performance of contamination monitors of the Geiger-Mueller type, proportional counter and scintillator was studied in standard fields of alpha and beta radiation, in relation to the same already listed tests. (author).

22358 (INIS-mf–13808, pp. 41) **Determination of characteristic quantities of the high-sensitivity whole-body counter in the AKH hospital of Vienna, Austria.** Warwitz, B. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Aiginger, H.; Unfried, E.; Steger, F.; Riedlmayer, L.; Bergmann, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. WHOLE-BODY COUNTERS/specifications; SPECIFICATIONS

22359 (INIS-mf–13808, pp. 44) **Radiation measurements at the surface of satellites and in the MIR space station.** Vana, N. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Schoener, W.; Fugger, M.; Akatov, J. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. MIR ORBITAL STATION/dose rates; SATELLITES/dose rates; COSMIC RADIATION; LET; SATELLITES; THERMOLUMINESCENT DOSIMETRY

22360 (INIS-mf–13808, pp. 46) **Development of a fully automated TLD evaluation system and its application in dosimetry and archaeology.** Henzinger, R.C. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Vana, N.; Kubelik, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ARCHAEOLOGICAL SPECIMENS/thermoluminescent dosimetry; PERSONNEL/thermoluminescent dosimetry; DATA PROCESSING; PERSONNEL

22361 (INIS-mf–13808, pp. 47) **Device for optical evaluation of nuclear track foils on a PC.** Vana, N. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Hofmann, P. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. PHOTOGRAPHIC FILM DETECTORS/ data processing

22362 (INIS-mf–13808, pp. 76) **Calculation of the resolution function of silicon detectors for alpha particles.** Steinbauer, E. (Johannes Kepler Univ., Linz (Austria). Inst. fuer Experimentalphysik); Bauer, P.; Bortels, G.; Biersack, J.P.; Burger, P. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SI SEMICONDUCTOR DETECTORS/ alpha particles; ENERGY RESOLUTION

22363 (INIS-mf–13808, pp. 167) **Radiation damage in silicon detectors.** Fellner, C. (Oesterreichische Akademie der Wissenschaften, Vienna (Austria). Inst. fuer Hochenergiephysik); Krammer, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SI SEMICONDUCTOR DETECTORS/ physical radiation effects; NEUTRONS

22364 (INIS-mf–13808, pp. 173) **Front-end electronics for silicon detectors.** Langhans, W. (Oesterreichische Akademie der Wissenschaften, Vienna (Austria). Inst. fuer Hochenergiephysik); Pernicka, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CERN/radiation detectors; RADIATION DETECTORS/electronic equipment; CERN; SPECIFICATIONS

22365 (INIS-mf–13808, pp. 176) **The silicon detector for the forward range of DELPHI.** Pernegger, H. (Oesterreichische Akademie der Wissenschaften, Vienna (Austria). Inst. fuer Hochenergiephysik); Krammer, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CERN/radiation detectors; CERN; SPECIFICATIONS

22366 (JINR-E–1-93-384) **Some characteristics of the superconducting magnetic system of toroidal spectrometer STORS.** Andreev, S.V. (and others); Vorozhtsov, S.B.; Kakurin, S.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1993. 34p. Order Number DE94626447. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nuclear Instruments and Methods.

A superconducting toroidal spectrometer (STORS) has been suggested to provide precision measurements of structure functions in muon beams. In this paper we present the calculation of the magnet induction and forces influencing the elements of the magnet, requirements to the reliability and rigidity of the carrying elements of the magnet construction. (author.) 14 refs.; 50 figs.; 4 tabs.

22367 (JINR-E–13-93-391) **Experimental study of non-power detectors for measurement of gamma-ray dose.** Jin Shengren (Northeastern Normal Univ., Changchun (China). Dept. of Physics); Li Mingfei. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 6p. Order Number DE94622572. Source: OSTI; NTIS (US Sales Only); INIS.

Several kinds of plate-type non-power detectors (capacitors) for measurement of gamma-ray dose have been made. The characteristics of non-power detectors with different structures are studied quantitatively. Several experimental results are given and systematically discussed. The possibilities and limits of the plate-type non-power detectors are discussed. (author.). 11 refs.; 5 figs.

22368 (JINR-R–13-93-399) **Automatic linear x-ray detector for investigation of the dynamics of the fast processes.** Vasil'ev, S.E.; Donets, D.E.; Zanevskij, Yu.V.; Ivanov, A.B.; Smykov, L.P.; Cheremukhina, G.A.; Chernenko, S.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 10p. (In Russian). Order Number DE94626448. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Pribory i Tekhnika Ehksperimenta.

The basic parameters of the automatic installation based on the one-dimensional x-ray detector on-line IBM P C AT are presented. The detector construction and operation, electronics system of data acquisition and processing and software are described. The detector is used to detect x-radiation at the range from 8 to 20 keV and to study a substance structure at the conditions of high temperatures and pressures and to receive the roentgenograms of different dynamic processes. Application of software and window menu provides maintenance. (author.). 7 refs.; 3 figs. 1 tab.

22369 (LA-SUB–94-74) **BMAP dipole magnetic field analysis and orbit tracking/Calculations of energy deposition in GaAs WHEBY detectors: Final report.** Humphries, S. Jr. (Acceleration Associates, Albuquerque, NM (United States)); Baltrusaitis, R.M.; Ekdahl, C.; Young, C.; Warn, C. Los Alamos National Lab., NM (United States); Acceleration Associates, Albuquerque, NM (United States). 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930269–26: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE94012080. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains two separate papers. The first paper discusses BMAP which is a versatile program for field analysis and orbit tracking in dipole magnets. The program was created to aid the design of charged-particle magnetic spectrometers. BMAP is written in Pascal and runs on any IBM-PC computer or compatible. The second paper covers a study on energy deposition in GaAS WHLEBY detectors. The study was done for two purposes: (1) to set up a three-dimensional electron-photon transport problem using the ACCEPT computer code; and (2) to calculate energy deposition in GaAs detectors in the WHEBY for a given flux of electrons.

22370 (LA-UR–94-1563) **Use of the WNR spallation neutron source at LAMPF to determine the absolute efficiency of a neutron scintillation detector.** Staples, P.A. (University of Massachusetts, Lowell, MA (United States). Dept. of Physics and Applied Physics); Egan, J.J.; Kegel, G.H.R.; Woodring, M.L.; DeSimone, D.J.; Lisowski, P.W. Los Alamos National Lab., NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–17: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012896. Source: OSTI; NTIS; INIS; GPO Dep.

Prompt fission neutron spectrum measurements at the University of Massachusetts Lowell 5.5 MV Van de Graaff accelerator laboratory require that the neutron detector efficiency be well known over a neutron energy range of 100 keV to 20 MeV. The efficiency of the detector, has been determined for energies greater than 5.0 MeV using the Weapons Neutron Research (WNR) white neutron source at the Los Alamos Meson Physics Facility (LAMPF) in a pulsed beam, time-of-flight (TOF) experiment. Carbon matched polyethylene and graphite scatterers were used to obtain a hydrogen spectrum. The detector efficiency was determined using the well known H(n,n) scattering cross section. Results are compared to the detector efficiency calculation program SCINFUL available from the Radiation Shielding Information Center at Oak Ridge National Laboratory.

22371 (LA-UR–94-1812) **The Los Alamos Calibration Laboratory for multi-spectral and thermal imaging radiometer systems.** Bender, S.; Maier, W.B. II; Byrd, D.; Holland, R.;

Michaud, F.D.; Moore, S.; Luettgen, A.; Weber, P. Los Alamos National Lab., NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9405163–1: Infrared radiometric sensor calibration symposium, Logan, UT (United States), 9-12 May 1994). Order Number DE94013130. Source: OSTI; NTIS; GPO Dep.

Los Alamos National Laboratory is currently constructing a calibration laboratory to support the radiometric calibration of remote earth sensing instrumentation. This laboratory will consist of a calibration station contained within a vacuum chamber whose output interface plane will provide a radiometrically characterized collimated optical beam of 16in. diameter. This output beam is fed to a thermal vacuum chamber where sensors under test are to be housed. The station will contain reference sources suitable for calibration of detectors from the visible and near infrared (VIS/NIR) to the thermal infrared. Design goals for these sources include absolute radiometric accuracies of better than 1% (3σ) for the thermal infrared up to 14 μm and VIS/NIR wavelengths up to 0.9 μm. For wavelengths between 0.9 μm and 2.5 μm, absolute accuracies of better than 3% are anticipated. Significant additional features of the calibration station design include: NIST support in the design and calibration of the radiometric sources, spectral characterization of the blackbody references, implementation of a vacuum compatible whitebody (integrating sphere) source, infrared resolution targets of variable contrast, and use of a scan mirror to duplicate target velocity vectors. This paper will provide an overview, description of the intended calibration station capability with further details provided in a companion paper also contained in these proceedings.

22372 (LBL–35403) **The STAR experiment at RHIC.** Marx, J.N. STAR Collaboration. Lawrence Berkeley Lab., CA (United States). Jan 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940169–5: 10. winter workshop on nuclear dynamics, Snowbird, UT (United States), 15-21 Jan 1994). Order Number DE94011911. Source: OSTI; NTIS; INIS; GPO Dep.

STAR (Solenoidal Tracker at RHIC) will be one of two large, sophisticated experiments ready to take data when the Relativistic Heavy Ion Collider (RHIC) comes on-line in 1999. The design of STAR, its construction and commissioning and the physics program using the detector are the responsibility of a collaboration of over 250 members from 30 institutions, world-wide. The overall approach of the STAR Collaboration to the physics challenge of studying collisions of highly relativistic nuclei is to focus on measurements of the properties of the many hadrons produced in the collisions. The STAR detector is optimized to detect and identify hadrons over a large solid angle so that individual events can be characterized, in detail, based on their hadronic content. The broad capabilities of the STAR detector will permit an examination of a wide variety of proposed signatures for the Quark Gluon Plasma (QGP), using the sample of events which, on an event-by-event basis, appear to come from collisions resulting in a large energy density over a nuclear volume. In order to achieve this goal, the STAR experiment is based on a solenoid geometry with tracking detectors using the time projection chamber approach and covering a large range of pseudo-rapidity so that individual tracks can be seen within the very high track density expected in central collisions at RHIC. STAR also uses particle identification by the dE/dx technique and by time-of-flight. Electromagnetic energy is detected in a large, solid-angle calorimeter. The construction of STAR, which will be located in the Wide Angle Hall at the 6 o'clock position at RHIC, formally began in early 1993.

22373 (ORNL/FTR–4867) **Travel to Switzerland to participate in tests of the prototype monolithic readout electronics for the 10,000-element lead-glass detector of CERN.** Young, G.R. Oak Ridge National Lab., TN (United States). 20 Dec 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004542. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler visited CERN from November 14–26, 1993, to participate in tests of the prototype monolithic readout electronics for the 10,000-element lead-glass detector of CERN experiment WA98. The tests were generally successful, paving the way for proceeding to final versions of the electronics and construction of the needed 10,000 channels of readout in time for the summer 1994 start-up run of WA98. The traveler also discussed PHENIX pixel pad-chamber electronics issues with Lund University members of PHENIX; WA98 lead-glass electronics funding issues with Lund University and GSI representatives; WA98 photon analysis issues and transportation of the WA98 lead-glass to BNL in early 1997 for use in PHENIX; and design of the PHENIX muon arm and its relevance to the CERN ALICE detector foreseen for the CERN Large Hadron Collider (LHC). The traveler attended talks on monolithic electronics and a seminar regarding nuclear energy production using a 1-GeV proton driver and a ^{232}Th target.

22374 (ORNL/FTR–4875) **Testing new technology for the heavy ion experiment at CERN: Foreign trip report, November 10–27, 1993.** Britton, C.L. Jr.; Simpson, M.L.; Walker, J.W.; Wintenberg, A.L. Oak Ridge National Lab., TN (United States). 17 Dec 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004747. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The travelers spent two weeks at the European Organization for Nuclear Research (CERN) working with G. R. Young of the Oak Ridge National Laboratory Physics Division to install and test prototype electronics developed for the lead-glass calorimeter of the WA98 experiment at CERN. These tests were generally successful, and information needed to finalize the design was obtained. Discussions involving both the ORNL personnel and other WA98 collaborators were also held to finalize the design of the electronics, production plans, production schedule, and installation schedule.

22375 (ORNL/TM–12481) **Nuclear accident dosimeter processing with attenuation filters.** Gunter, R.J. Oak Ridge National Lab., TN (United States). May 1994. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013080. Source: OSTI; NTIS; INIS; GPO Dep.

An evaluation of the Martin Marietta Energy Systems, Inc., Personnel Nuclear Accident Dosimeters was undertaken to determine if they could meet DOE 5480.11 requirements for photon dose assessment. Dosimeters were irradiated with a ^{137}Cs source to doses ranging from 0.5 to 10,000 rad and processed using transmission filters to prevent photomultiplier tube saturation. Dose equivalent responses were found to meet the requirements using dosimeter reader number 55. Use of reader number 11 revealed a problem with current procedures. While performing a normal calibration with transmission filters in place it was discovered that there was a high noise component in the calibration signal, resulting in a poor calibration. Dosimeters processed with reader number 11 using a 1% transmission filter determined element 3 response 30% below expectations. The low element 3 response resulted in a significantly lower dose calculation for affected dosimeters. Another factor affecting overall response was an excessive supralinearity correction applied to dosimeters exposed between 100 and 1,000 rad.

22376 (PNL-SA–22854) **Enhanced portability of safeguards measurements tools.** Swinth, K.L.; Brackenbush, L.W.; Braby, L.A.; Eschbach, P.A. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940307–29: International symposium on nuclear material safeguards, Vienna (Austria), 14-18 Mar 1994). Order Number DE94011680. Source: OSTI; NTIS; INIS; GPO Dep.

In recent years, computers have decreased in size from cubic meter volumes to units that can fit in the palm of the hand. At the same time, the capability of the computers has increased due to both faster electronics and improvements in software. Similar changes have occurred in other electronic devices, primarily because of the decrease in size of the electronics and the incorporation of smart electronics (microprocessors). Similar decreases in the size of the detectors used in radiation detection, however, have not yet occurred. Reduction in detector size requires advances in materials to provide higher efficiency in a smaller volume. Improved intrinsic efficiency of detectors does not always meet safeguards needs because resolution of individual photopeaks may be more important than efficiency. Recent advances at the Pacific Northwest Laboratory have led to smaller multichannel analyzers and more compact detector electronics. In related studies, the performance of the new scintillation detectors has been explored.

22377 (SAND–93-2236C) **Calibration and characterization of a low level waste assay system.** Giesler, G.C. (Excel Technical and Environmental Services, Inc. (United States)); Henry, S.A.; Johnson, S.L.; Vehar, D.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940225–17: Waste management '94, Tucson, AZ (United States), 27 Feb - 3 mar 1994). Order Number DE94006592. Source: OSTI; NTIS; INIS; GPO Dep.

In today's rapidly changing regulatory environment, increasingly detailed information is required about the composition of items intended for disposal. We have examined a system that can be used to measure the radioactivity in a container of waste destined for disposal. In order to better understand the capabilities and limitations of the system, we performed a number of measurements to calibrate and characterize this system. The results of this characterization including detectability limits for ^{235}U and $_{239}Pu$ are presented.

22378 (SAND–94-0075) **Time Projection Compton Spectrometer (TPCS): User's guide.** Landron, C.O. (Sandia National Labs., Albuquerque, NM (United States)); Baldwin, G.T. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 182p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011408. Source: OSTI; NTIS; GPO Dep.

The Time Projection Compton Spectrometer (TPCS) is a radiation diagnostic designed to determine the time-integrated energy spectrum between 100 keV – 2 MeV of flash x-ray sources. This guide is intended as a reference for the routine operator of the TPCS. Contents include a brief overview of the principle of operation, detailed component descriptions, detailed assembly and disassembly procedures, guide to routine operations, and troubleshooting flowcharts. Detailed principle of operation, signal analysis and spectrum unfold algorithms are beyond the scope of this guide; however, the guide makes reference to sources containing this information.

22379 (SSCL-SR–1225, pp. 45-51) **Design choices and issues for collider experiments.** Spalding, J. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This presentation discusses the technical considerations in the design of B physics experiments at hadron colliders. B physics at hadron colliders is already a broad on-going program and the physics community is just learning how to do it, both in terms of the technology and the analysis techniques. The initial results for CDF are very encouraging and the upgrades to CDF and D0 will extend this program in the future to include the study of rare decays, B_S-mixing, and CP-asymmetries. Over the next few years the efficiencies and dilutions will be measured for lepton tagging, and for tagging via associated pions, allowing reliable estimates to be made for the future. Achieving sufficiently high data rates and background rejection requires the development of high speed data acquisition and triggering, and precision vertex detectors. While the D0 and CDF detectors, and the major detectors planned at SSC and LHC are primarily intended for high p_t physics, they will be capable of extensive B physics. The full exploitation of the potential at hadron colliders may however require a dedicated experiment, optimized for low p_t and very high rates, perhaps with a forward geometry. The choice of rapidity coverage, forward versus central, is driven by the issues of trigger strategies and rates, vertex detector design and tracking performance, and particle ID.

22380 (SSCL-SR–1225, pp. 53-62) **Design choices and issues in fixed-target B experiments.** Camilleri, L. (PPE Division, Geneva (Switzerland)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The main priority of any experiment on B physics in the years to come will be an endeavour to observe CP violation in the B sector. Such measurements imply the following requirements of the experiment. Trigger: a muon trigger will be sensitive to J/ψ reactions and muon tags; an electron trigger will double the number of lepton events; in order to include kaon tags and self-tagging reactions, the experiment must not rely entirely on lepton triggers. Secondary Vertex triggers and hadron p_T triggers should be included in order to have the maximum flexibility. Detector: vertex detector; particle identification; good momentum resolution; electromagnetic and hadronic calorimeters; muon detector. In addition the following issues have to be addressed: Collider or fixed-target mode? If fixed target, extracted beam or internal target? If internal target, gas jet or wire target? If a gas jet, hydrogen or a heavy gas? Beam pipe design. Silicon microvertex design and radiation damage. K_s^0 decay path. Particle identification. Momentum resolution. Order of detectors. No single method stands out as the "obvious one." An extracted beam yields better vertex resolution and an internal target easier triggering. A flexible and diverse triggering scheme is of prime importance in order to be sensitive to as many reactions as possible, the experiment should not be limited to lepton triggers only. Proposed experiments (P867, HERA B) at existing machines will be invaluable for testing new devices and strategies for the LHC and SSC experiments.

22381 (SSCL-SR–1225, pp. 139-150) **Secondary particle background levels and effects on detectors at future hadron colliders.** Pal, T. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC35-89ER40486. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The next generation of hadron colliders, the Superconducting Super Collider (SSC) and the Large Hadron Collider (LHC), will operate at high center-of-mass energies and luminosities. Namely, for the SSC(LHC) $\sqrt{s}$=40TeV ($\sqrt{s}$=16TeV) and $L=10^{33}cm^{-2}s^{-1}$ ($L=3\times10^{34}cm^{-2}s^{-1}$). These conditions will result in the production of large backgrounds as well as radiation environments. Ascertaining the backgrounds, in terms of the production of secondary charged and neutral particles, and the radiation environments are important considerations for the detectors proposed for these colliders. An initial investigation of the radiation levels in the SSC detectors was undertaken by D. Groom and colleagues, in the context of the "task force on radiation levels in the SSC interaction regions." The method consisted essentially of an analytic approach, using standard descriptions of average events in conjunction with simulations of secondary processes.

22382 (SSCL-SR–1225, pp. 227-228) **A $B^0 \rightarrow \pi^+\pi^-$ trigger for CDF.** Punzi, G. (INFN Via Livorness, Pisa (Italy)); Donati, S.; Gagliardi, G. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The authors have studied how to implement in CDF a trigger for the process $B^0 \rightarrow \pi^+\pi^-$, exploiting the new trigger hardware being built for Run II (1996/1997). The trigger they propose is based on online measurement of impact parameters, a very important handle for a decay channel that is otherwise almost featureless. The new devices that will make this trigger possible are, at Level 1, the new fast tracker for the Central Drift Chamber (XFT) and, at Level 2, the Silicon Vertex Tracker (SVT), allowing online tracking in the new Silicon Vertex detector (SVX II). They evaluate rates and efficiency of the proposed trigger, and discuss its feasibility.

22383 (SSCL-SR–1225, pp. 463-473) **Tracking and vertexing for B physics at hadron accelerators.** Johnson, R. (Univ. of California, Santa Cruz, CA (United States)); Purohit, M.; Weidemann, A.W. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In

Proceedings of the workshop on B physics at hadron accelerators. 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In this note, the authors report on some of the activities of the Tracking and Vertexing Working Group of this Workshop. Track and vertex finding is essential to exploit the high production rate of B-mesons at hadron accelerators, both for triggering and analysis. Here, they review the tracking and vertex-finding systems of some of the major existing and proposed collider and fixed-target experiments at existing and future hadron accelerators, with a view towards their usefulness for B-physics. The capabilities of both general-purpose detectors and those of dedicated B-physics experiments are considered.

22384 (SSCL-SR–1225, pp. 475-477) **SDC tracking capabilities for B physics.** Coupal, D.P. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The $b\bar{b}$ production cross section is estimated to be 1 mb at $\sqrt{s}$ = 40 TeV, implying 10^{12} produced $b\bar{b}$ pairs at an SSC luminosity of $10^{32}cm^{-2}sec^{-1}$ (0.1 x design). SDC has the potential to exploit this high rate to explore a number of B physics topics, in particular, CP violation in the neutral B meson. This note describes the SDC particle tracking design and its predicted performance parameters relevant to B physics.

22385 (SSCL-SR–1225, pp. 479-483) **Comparison of forward collider vertex detectors for B physics at hadron accelerators.** Harr, R.F. (Yale Univ., New Haven, CT (United States)); Karchin, P.E.; Kennedy, C.J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Two silicon vertex detector designs have been proposed for a forward collider B physics experiment at the SSC: in one the silicon system is put outside the beampipe (like in the forward part of the proposed BCD detector); and in the other the silicon system is put inside the beampipe, close to the circulating beams, with the use of 'roman pots' (as in the COBEX proposal). In what follows these will be referred to as the inside and outside designs. The two designs are significantly different in their construction and impact on the rest of the experiment. The authors would like to understand how the designs compare for doing B physics and what are the factors that most greatly influence the results. Two measurements relying on the vertex detector and of particular importance for B physics are the reconstructed vertex position and B mass. They have analyzed the resolution achievable in these 2 quantities for 'models' of the two forward collider vertex detector designs. The design parameters - beampipe radius and thickness, silicon position and resolution, etc. - have been varied about their normal values to observe their effect on these resolutions. They find very little difference between the two designs; both give nearly the same decay length error, impact parameter error, and reconstructed B mass error, for a large range of geometrical parameters. The design parameter having the most significant impact on the errors of B decay vertices is found to be the point resolution of the silicon detectors.

22386 (SSCL-SR–1225, pp. 485-488) **Tracking considerations for fixed target B experiments at SSC and LHC.** McManus, A.P. (Univ. of Virginia, Charlottesville, VA (United States)); Conetti, S.; Corti, G.; Cox, B.; Dukes, E.C.; Lawry, T.; Nelson, K.; Tzamouranis, I. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Fixed target beauty (B) experiments proposed at the SSC or LHC come in two basic types. Extracted beam experiments use a bent crystal of silicon or some other method to extract a beam of protons parasitically from the circulating beam as the collider experiments are taking data. The two chief extracted beam experiments are the LHB collaboration at the LHC and the SFT collaboration at the SSC. The second type of fixed target experiment places the detector around the circulating beam using a gas jet or thin wire(s) as a target. The (GAJET) experiment proposed at CERN for LHC and the Hera-B experiment at DESY are of this type.

22387 (SSCL-SR–1225, pp. 489-495) **On the configuration of an active target for a fixed-target B experiment at SSC energies.** Dukes, E.C. (Univ. of Virginia, Charlottesville, VA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The optimal configuration of target and silicon microvertex detector for fixed-target B experiments has yet to be determined. For fixed-target charm experiments the usual setup consists of a series of inert target foils - typically a few millimeters thick and separated by a few centimeters - immediately followed by a silicon microvertex detector. Because of the larger boost at the SSC, the efficacy of using active target foils - tightly packed silicon microstrip detectors - has been considered by at least one group: the SFT collaboration. It is hoped that with an active target the tracks of charged B's themselves can be measured, improving charged B reconstruction efficiencies. The author examines two issues concerning silicon active targets for fixed-target experiments at the SSC: (1) the effect on the acceptance of the requirement that the B decay vertices occur outside of the target foils, and (2) the ability of an active target to directly track charged B's.

22388 (SSCL-SR–1225, pp. 497-501) **A realistic study on a forward geometry collider spectrometer: Performance of a typical fixed target spectrometer at the tevatron collider.** Lebrun, P. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The performance of a forward heavy quark experiment at the collider can be estimated in a very realistic way, by simply carrying an existing fixed target spectrometer (E687) to the Tevatron Collider, changing only the beam/target configuration while keeping all reconstruction cuts identical to those used in reconstructing real charmed particles collected during the last fixed target run. Based on the golden - and typical - decay mode $D \rightarrow K\pi\pi$, it is found that the overall charm acceptance x efficiency is $\approx$ 3%, the 5-body B decay $B \rightarrow D\pi\pi$ being about .6%. Such an experiment compares very favorably to E-831 and has real potential to study in great detail doubly suppressed Cabbibo decays and to observe D^0 - D^0 mixing. In addition, this exercise allows one to perform a rough but effective reality check on similar design (e.g. COBEX).

22389 (SSCL-SR–1225, pp. 505-510) **Summary of the electron ID group.** Dukes, E.C. (Univ. of Virginia, Charlottesville, VA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Lepton identification is extremely important for any B physics experiment attempting to measure CP violation. The reasons are obvious: (1) single lepton triggers operate on 44% of all $b\bar{b}$ pairs; (2) lepton triggers are the only triggers (outside of secondary vertex triggers) that are feasible for a variety of important B decay modes; for example, $B^0 \rightarrow D^+D^-$, $B^0 \rightarrow J/\psi K_s$, and $B_s \rightarrow K_s\gamma$; and (3) events triggered with leptons are already tagged. The electron identification group focused its efforts on learning what state-of-the-art collider detectors are doing in electron identification. To this end they entertained several talks each from the CDF and D0 collaborations at Fermilab, as well as several talks from proposed SSC

and LHC experiments. Each talk was followed by lively discussion. They also attempted to understand what the backgrounds to electron identifications will be at the new higher energy hadron colliders - the SSC and LHC - their prejudice being that only these machines will have the energy and luminosity needed to see CP violation in the B system. None of the approved experiments at the SSC or LHC is optimized for B physics. Hence they focused on dedicated forward collider and fixed target detectors.

22390 (SSCL-SR–1225, pp. 511-513) **Improvement in the CDF L2 electron trigger using the central shower max detector.** Byrum, K.L. (Argonne National Laboratory, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

As part of a trigger upgrade for CDF run 1b, new electronics will bring the central shower max detector (CES) into the 'level-2' trigger algorithm. This upgrade will allow the trigger to select electrons within a finer segmentation in the r - ϕ view. This will be achieved by requiring a pulse height in the shower max detector be associated with a projected track from the central fast tracker to within 2 degrees. In CDF run Ia, the track was only required to point to the same 15 degree wedge as the electron electromagnetic cluster. This tighter matching will decrease the 'level-2' electron cross section by about a factor 2, while maintaining the electron purity.

22391 (SSCL-SR–1225, pp. 515-518) **Electron identification in the D0 detector.** Denisenko, N. (Fermi National Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The author presents the characteristics of the D0 detector together with the methods applied to identify electrons. The electron identification technique uses calorimeter information together with data from the central tracking detectors. The fine longitudinal and transverse segmentation of the D0 calorimeter enables the achievement of very good pion rejection for electrons above 20 GeV. The D0 calorimeter also provides excellent linearity of response for electrons above 110 GeV. Here the author presents recent results of studies of energy response for electrons with energy down to 2 GeV and discusses necessary extensions of electron identification algorithms for B-physics studies.

22392 (SSCL-SR–1225, pp. 519-522) **Identifying B-jets with electrons.** Peryshkin, A. (Fermilab, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A possibility of detecting electrons from b-quark decays with the D0 detector is considered in this note. The efficiency and a purity estimations based on a Monte Carlo studies are presented as well.

22393 (SSCL-SR–1225, pp. 523-527) **Electromagnetic shower spectroscopy in a high rate hadronic interaction environment; Fermilab experiment E760 performance.** Marques, J.L. (Northwestern Univ., Evanston, IL (United States)); Rosen, J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

As far as electro-magnetic shower spectroscopy is concerned, the emphasis of the 1993 Snowmass B-physics Workshop has been colored by the nature and operating performance of existing hadronic colliders (principally CDF and D0). It is important to note that these detectors are (1) primarily concerned with detection in central rapidity, (2) very coarsely sectorized, (3) primarily designed for $W^{\pm}$, Z^0, and top decays, and (4) deeply concerned with hermeticity (i.e. preservation of the transverse energy balance for neutrino purposes). These design considerations do not reflect those of B physics. For example, hermeticity is irrelevant to B spectroscopy per se. A fine grained shower calorimeter is capable of (1) excellent electron-hadron separation which is essential for measurements of semi-electronic decays of B's and D's down to moderately low $p_{\perp}$, (2) good γ, π^0, η, η', $\omega \rightarrow \pi^0\gamma$, and $K^0_s \rightarrow \pi^0\pi^0$ reconstruction. E760 is an experiment devoted to the study of resonant charmonium production initiated by proton-antiproton annihilations. The authors present this paper to invite readers to look at its performance in terms of the needs of a B meson decay experiment.

22394 (SSCL-SR–1225, pp. 531-536) **Summary muon detection working group.** Stanton, N.R. (Kansas State Univ., Manhattan, KS (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The areas of concentration of the Muon Working Group reflected its composition: about half of the group was interested primarily is extending the capability of existing general purpose colliders (CDF, D0). Smaller numbers of people were interested in B physics with general purpose colliders at the SSC and LHC, with SSC fixed target experiments, and with dedicated forward colliders. Good muon tagging, and possibly also muon triggering, is essential for studying CP violation in $B_l \rightarrow J/\psi X$, $J/\psi \rightarrow \mu^+\mu^-$; as a flavor tag, with the semimuonic decay $B \rightarrow \mu^+ X$ or $\bar{B} \rightarrow \mu^- X$ tagging the flavor of the partner; for studying the physics of the semimuonic B decays themselves; and for looking for really rare decays like $B \rightarrow \mu^+\mu^-$.

22395 (SSCL-SR–1225, pp. 537-541) **Muon identification and triggering at D0.** Cummings, M.A.C. (Univ. of Hawaii, Honolulu (United States)); Hedin, D.; Johns, K. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The D0 detector is a large, general-purpose detector to take full advantage of the 2 TeV energy of the Fermilab collider. The design of the experiment emphasizes accurate identification, complete angular acceptance, and precise measurement of the decay products of W and Z bosons: charged leptons (both electrons and muons), quarks and gluons, which emerge as collimated jets of particles, and noninteracting particles, such as neutrinos. The primary physics goals of D0 include searching for new phenomena, such as the top quark or particles outside the Standard Model, and high-precision studies of the W and Z bosons. In addition, the excellent muon identification allows the study of b quark production and decay. The D0 detector consists of three major hardware systems: calorimetry, muon detection, and central tracking, which together allow fairly complete characterization of most proton-antiproton collision events. The central tracking system consists of four drift-chamber systems (vertex, central, and two end systems) and transition radiation detectors for electron identification. Surrounding the central tracking system are three uranium/liquid-argon calorimeters. The uranium is a dense medium, allowing containment of high energy hadron showers in a relatively short depth, as well as equal response to electrons and hadrons, while the liquid-argon ionization medium gives ease of calibration, stability, radiation hardness, and the ability to build in fine segmentation in all three coordinates. The energy resolution due to sampling fluctuations alone is $\sigma/E \approx 16\%/\sqrt{E}$ for electrons and $\approx 49\%/\sqrt{E}$ for charged pions. Surrounding the calorimeters is the muon system which the author describe in this paper.

22396 (SSCL-SR–1225, pp. 543-548) **The CDF muon system.** LeCompte, T.J. (Univ. of Illinois, Urbana-Champaign, IL (United States)); Papadimitriou, V. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The authors describe the characteristics of the CDF muon system and their experience with it. They explain how the trigger works and how they identify muons offline. They also describe the future upgrades of the system and their trigger plans for Run IB and beyond.

22397 (SSCL-SR–1225, pp. 551-556) **Summary of the hadron ID group.** Nelson, K.; Sheaff, M.; Aleksen, R.; Alexopoulos, T.; Artuso, M.; Cox, B.; DeJongh, F.; Giomataris, J.; Jain, V.; Kennedy, C. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The members of the Hadron ID Working Group represented a wide spectrum of experimental environments and detector expertise. On most afternoons, two or three speakers presented results from detectors used for particle identification. The majority of the presentations were reports on the performance of detectors used in current generation experiments, but some detailed the results of more speculative work being performed in the framework of detector research and development for expected future experiments or upgrades to existing experiments. One session was held jointly with the Electron ID Working Group because the talks on Transition Radiation Detectors and the Hadron Blind Detector were of interest. One of the more noteworthy features of this working group was the large representation and contribution from members of the CLEO collaboration, despite the fact that this workshop was organized to discuss B physics at hadron accelerators. The present CLEO experiment utilizes dE/dx and time-of-flight (TOF) detectors for particle identification. Three standard deviation pion/kaon separation is achieved by the former up to ~.7 GeV/c and the latter up to .9 GeV/c. Members of the group are carrying out an aggressive research program to develop techniques for extending the hadron ID capability to at least the 2.5 GeV/c needed for the symmetric collider program and even beyond this to the 4 GeV/c required for the proposed asymmetric machine of the future. In order to provide space for the hadron ID upgrade, it will be necessary to improve the capabilities of the tracking system to attain the same resolutions as previously achieved by in 20 cm less radial space.

22398 (SSCL-SR–1225, pp. 557-559) **Comparison of particle identification methods.** Kwan, S. (Fermi National Accelerator Lab., Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

There are four primary methods for hadron identification which can be applied in a B experiment: (1) Time of flight (TOF); (2) ionization loss (dE/dx); (3) Cherenkov radiation, including Ring Imaging Cherenkov counters (RICH), threshold counters and various novel ideas such as the internally reflected Cherenkov imaging counters (DIRC) and the Hadron Blind Detector and (4) transition radiation. No single device is able to cover the wide range of momentum of hadrons from the central collider geometry to the fixed target configuration at the SSC/LHC. Both the TOF and the dE/dx are useful only at low momentum and their use has been restricted to central collider geometry in hadron machines or e^+e^- machines. Even there, a combination of the two methods or with Cherenkov counters is required to give the whole range of momentum coverage. On the other hand, a RICH can be useful at central or forward collider experiments and fixed target experiments as well as e^+e^- experiments (e.g. DELPHI, SLD) including B-factories. For the high momentum domain in the fixed target experiments for the SSC/LHC, a TRD is needed to cover the momentum range from 200 GeV/c up to 500 GeV/c. Here the author briefly compares the performance of a Cherenkov threshold system, RICH, and TOF.

22399 (SSCL-SR–1225, pp. 561-567) **Use of transition radiation detectors (TRD's) for B tagging/triggering in future collider or fixed target experiments.** Sheaff, M. (Univ. of Wisconsin, Madison, WI (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. NSF PHY-86-15287; PHY-89-01274. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Transition Radiation Detectors (TRD's) have been used successfully for particle identification in high energy physics experiments over approximately the last ten years. They have been utilized in a variety of experimental environments, including the Intersecting Storage Rings at CERN, hadron collider experiments at the CERN SppS and at the Fermilab Tevatron, and an internal gas jet target experiment at the CERN SppS as well as fixed target experiments at both laboratories. The primary application has been electron identification, but, more recently, they have been used to identify hadrons as well, including both primary beam particles and secondaries in the very forward region of a multiparticle spectrometer. These versatile detectors show great promise for use in the identification of B decay products in future heavy quark experiments at hadron accelerators. While their anticipated role in the central or moderately forward region of the collider would be to identify electrons, in fixed target or in the very forward collider region, they would be expected instead to discriminate among hadron species. This is because the total TR energy radiated is proportional to the Lorentz factor, γ, of the the charged particle. Thus, a TRD which 'turns on' for electrons between 1 and 2 GeV demonstrates the same response to pions only when they reach an energy of 250-500 GeV.

22400 (SSCL-SR–1225, pp. 569-573) **Fast ring imaging detectors for forward B collider experiments.** Artuso, M. (Syracuse Univ., NY (United States)); Mukhin, Y. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A good hadron identification system is a crucial element in an experiment designed to measure CP violation asymmetries in B decays. In particular the reactions $B \rightarrow \pi^+\pi^-$ and $B \rightarrow K^\pm\pi^\mp$ need to be disentangled with high accuracy. note Thet the kinematics of the reactions $B \rightarrow \pi^+\pi^-$ and $B \rightarrow K^\pm\pi^\mp$ are so similar that conventional particle identification approaches have no chance to provide adequate separation between these two decay channels. An experiment designed to detect B's produced in the forward direction in a hadron collider has the advantage of having enough longitudinal space to allow the insertion of a fast Ring Imaging Cherenkov (RICH) detector, which should suit both the particle identification needs and the processing speed required at SSC. In order to set the scale for the momentum coverage needed, simulation studies have indicated that most particles coming from B decays at SSC have a momentum smaller or roughly equal to 100 GeV. In the next section the performance expected for a typical fast RICH detector suitable for this application is discussed. The fast RICH detector considered in this present study can be located downstream of the tracking system. Tha authors show that a single gaseous fast RICH can accomplish the physics goals, namely that the lowest momentum at which the particle species need to be unambiguously identified is of the order of a few GeV, corresponding to the threshold of the most common gas radiators.

22401 (SSCL-SR–1225, pp. 575-582) **Hadron identification in a fixed target experiment at the SSC.** Nelson, K.S. (Univ. of Virginia, Charlottesville, VA (United States)); Cox, B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This article presents the design criteria and expected performance of a hadron identification system in a fixed target experiment at the SSC. The proposed SFT spectrometer will be used as a model for the discussion. Two primary uses of hadron identification is a B physics experiment are flavor tagging and the rejection of background due to particle reflections in the reconstruction of exclusive decay modes. In the first case it is shown that use

of kaons can increase substantially the number of events which can be tagged. In the latter case, decays in which particles are mis-identified can form a background to a desired decay mode.

22402 (SSCL-SR–1225, pp. 583-584) **Experience with dE/dx at CDF.** Lewis, J.D. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Prior to the 1992-93 Tevatron collider run, the CDF Central Tracking Chamber (CTC) was instrumented to measure charge deposition in addition to drift times for the outer 54 of its 84 sense wire layers in order to measure specific ionization (dE/dx). The Amplifier-Shaper-Discriminator (ASD) cards were modified to include charge integration. The amplifier output is discharged at a constant rate, converting the integrator pulse height to the width of the discriminated pulse. LeCroy 1879 TDC's measure both the arrival time and the width of a pulse. A typical pulse width from a minimum ionizing particle is 12 counts or 24 ns. However, the limited resolution does not present a problem because primary ionization statistics yield an expected single pulse resolution of 40%. The author expands on applications and adaptations of these specific ionization detectors, within the CDF detector, and with respect to the needs of a B detection system.

22403 (SSCL-SR–1225, pp. 587-588) **Electronics, trigger, data acquisition, and computing working group on future B physics experiments.** Geer, S. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Electronics, trigger, data acquisition, and computing: this is a very broad list of topics. Nevertheless in a modern particle physics experiment one thinks in terms of a data pipeline in which the front end electronics, the trigger and data acquisition, and the offline reconstruction are linked together. In designing any piece of this pipeline it is necessary to understand the bigger picture of the data flow, data rates and volume, and the input rate, output rate, and latencies for each part of the pipeline. All of this needs to be developed with a clear understanding of the requirements imposed by the physics goals of the experiment; the signal efficiencies, background rates, and the amount of recorded information that needs to be propagated through the pipeline to select and analyse the events of interest. The technology needed to meet the demanding high data volume needs of the next round of B physics experiments appears to be available, now or within a couple of years. This seems to be the case for both fixed target and collider B physics experiments. Although there are many differences between the various data pipelines that are being proposed, there are also striking similarities. All experiments have a multi-level trigger scheme (most have levels 1, 2, and 3) where the final level consists of a computing farm that can run offline-type code and reduce the data volume by a factor of a few. Finally, the ability to reconstruct large data volumes offline in a reasonably short time, and making large data volumes available to many physicists for analysis, imposes severe constraints on the foreseen data pipelines, and a significant uncertainty in evaluating the various approaches proposed.

22404 (SSCL-SR–1225, pp. 589-593) **Comparison of trigger and data acquisition parameters for future B physics experiments.** Conetti, S. (Univ. of Virginia, Charlottesville, VA (United States)); Geer, S. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The main task of the Trigger and Data Acquisition Working Group was to collect the global parameters of the Trigger/DA schemes envisaged by various approaches to future hadronic B physics, and to perform a zeroth order comparison of the overall performances. The data are presented in tables appended to the text. The level of reliability for the performance figures reported in the tables covers a wide range, due to the large variation in the procedures followed to derive the actual numbers. In order of decreasing reliability, sources of estimates were: extrapolations from data; full detector and trigger simulation (with or without support from data); event generation (e.g. Phytia) plus smearing to simulate detector response; educated guess; performance goal, rather than actual projection. The compilations show that dedicated B detectors are able to address at the trigger level the whole spectrum of B decays, as opposed to just collecting $B \rightarrow J/\psi$ events and that the appropriate trigger strategy is a combination of high p_T leptons, high p_T hadrons and vertex/impact parameter triggers. The performance required of the trigger/DA systems appears to be, with some possible exceptions, well within today's technology, or at most a mild extrapolation of it. Dedicated detectors should be able to log inclusive B events at the rate of up to a few hundred per second, or for rare decays of the type e.g. $B \rightarrow \pi\pi$, of a few tens per hour.

22405 (SSCL-SR–1225, pp. 595-597) **Triggering at the SFT.** Conetti, S. (Univ. of Virginia, Charlottesville, VA (United States)); Arenton, M.; Corti, G.; Cox, B.; Dukes, C.; Lawry, T.; Tzamouranis, I.; Erwin, A. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

One essential feature of a fixed target B experiment, when compared to collider detectors, is the much better performance achievable at the trigger level in terms of background rejection for a given signal retention. To a large extent this is due to the fact that, in the fixed target environment, transverse momenta carried by products of B decay are larger than those typical of minimum bias interactions. In view of this, the SFT trigger strategy is strongly based upon the transverse momentum characteristics of the events, requiring at the first level, suitable combinations of P_T cuts on leptons and hadrons; in this article, the authors discuss separately the muon, electron and hadron triggers, and then show how they can be combined to achieve the required global performance. Next, they will discuss how the unique properties of the SFT live target allow the implementation of a multiplicity jump, multi-vertex trigger, providing a further level of rejection at higher levels of triggering.

22406 (SSCL-SR–1225, pp. 599-601) **COBEX trigger and data acquisition parameters.** Hartouni, E.P. (Univ. of Massachusetts, Amherst, MA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. Grant PHY90-14879. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

COBEX (Colliding Beauty Experiment) is an open geometry forward spectrometer dedicated to exploring B-physics and designed to run at a hadron collider. Its principle design features allow it to exploit the expected large forward hadro-production rate of B-mesons. COBEX will be capable of providing large data samples of reconstructed, exclusive B-mesons decays with good measurements of the decay proper lifetimes, mass and initially produced flavors (i.e. tagging). This talk limits itself to a description of the triggering and data acquisition parameters required by COBEX to achieve its physics goals.

22407 (SSCL-SR–1225, pp. 603-604) **Part 2 of the summary for the electronics, DAQ, and computing working group: Technological developments.** Slaughter, A.J. (Yale Univ., New Haven, CT (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The attraction of hadron machines as B factories is the copious production of B particles. However, the interesting physics lies in specific rare final states. The challenge is selecting and recording

the interesting ones. Part 1 of the summary for this working group, 'Comparison of Trigger and Data Acquisition Parameters for Future B Physics Experiments' summarizes and compares the different proposals. In parallel with this activity, the working group also looked at a number of the technological developments being proposed to meet the trigger and DAQ requirements. The presentations covered a wide variety of topics, which are grouped into three categories: (1) front-end electronics, (2) level 0 fast triggers, and (3) trigger and vertex processors. The group did not discuss on-line farms or offline data storage and computing due to lack of time.

22408 (SSCL-SR–1225, pp. 605-606) **Report of the subgroup on deadtimeless front-end electronics.** Shepard, P.F. (Univ. of Pittsburgh, PA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The subgroup on deadtimeless front-end electronics and data acquisition systems met for two days on June 28-29. This report summarizes some of the material presented at these discussions. It concentrates on the need for and technical obstacles to the development of high rate deadtimeless front-end electronics for silicon vertex trackers. The large yield of $b\bar{b}$ events at hadron colliders indicate the desirability of level 1 trigger rates of order 50-100 kHz. In order to eliminate undesirable deadtime the required front-end electronics needs to be fully pipelined and capable of supporting subsequent trigger levels without incurring any deadtime. In these discussions it has been assumed that the level 1 latency time is of order 2-4 μs.

22409 (SSCL-SR–1225, pp. 607-609) **An impact-parameter optical discriminator for B decays.** Giomataris, Y. (Lousanne Univ. (Switzerland)); Loucatos, S. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

At future hadron machines (LHC, SSC) the b-production cross-section in fixed-target experiments is sufficiently large to allow observation of CP-violation in the $B\bar{B}$ system. Provided that the size of the target is small, the precise knowledge of the primary vertex, is a strong advantage over collider experiments. At the LHC, a luminosity of 2×10^{33} $cm^{-2}s^{-1}$ in a small interaction region can be achieved using a thin jet target. The ratio of $\sigma_{b\bar{b}}$ to σ_{tot} is 10^{-5}, the bunch crossing rate is expected to be 40 MHz and the interaction rate 70 MHz. The time between two interactions (25 ns) requires pipe-line architecture of a silicon microvertex trigger. A fast first-level selection of the events can reduce the input ratio into a Si trigger and hence the depth of the pipe-line. The optical discriminator, described hereafter, is a possible solution. The idea is to use the Cerenkov light emitted by charged particles crossing a spherical crystal shell and retain those having a sizeable impact parameter with respect to the center of the sphere where the target is located.

22410 (SSCL-SR–1225, pp. 611-613) **The P_t selection of B events with the optical discriminator.** Giomataris, Y. (Lousanne Univ. (Switzerland)); Derre, J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The selection of B's by an optical P_t discriminator is very promising and gives higher efficiency in the fixed-target mode. It is a very fast, global trigger, independent of the decay mode. It is a way to improve the efficiency for B-meson pair selection in existing collider experiments suffering important losses caused by trigger limitations. It can be used for future Beauty investigations in very high luminosity proton collisions. The effect of a deterioration of the obtained rejection due to gamma conversions in the crystal needs further studies. The implementation of a toroidal magnet in such an experiment is also an open question.

22411 (SSCL-SR–1225, pp. 615-616) **A multiplicity jump trigger using silicon planes.** Alexopoulos, T. (Univ. of Wisconsin, Madison, WI (United States)); Erwin, A.R. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Since silicon tracking planes are already present in a B decay experiment, it is an attractive idea to use these as part of a multiplicity jump detector. Two average B decays would produce a multiplicity jump of around 10 in the final state. Such a trigger has been tried for a fixed target Charm experiment with disappointing success. The failure was attributed to the difficulty in adequately controlling the gains of a large number of microstrip amplifies.

22412 (SSCL-SR–1225, pp. 617-623) **Impact parameter trigger and vertex detector for forward collider.** Selove, W. (Univ. of Pennsylvania, Philadelphia, PA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In a forward collider design, Coulomb scattering produces an unavoidable smearing of the vertex region by low-p_t tracks. A detector and triggering design is described which aims at differentiating B events from minimum bias events with high efficiency, in spite of this smearing, by measuring momentum and p_t of all tracks in real time, and triggering only when an event shows a number of high-p_t tracks with substantial impact parameters. Triggering efficiency an order of magnitude larger than for a lepton trigger can be anticipated. Detector planes are located within 4 millimeters of the beam line; a replaceable-vertex-region design provides for rapid replacement of radiation damaged closest elements at time intervals of a few months.

22413 (SSCL-SR–1225, pp. 625-627) **Real-time tracking with a 3D-flow processor array.** Crosetto, D. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The problem of real-time track-finding has been performed to date with CAM (Content Addressable Memories) or with fast coincidence logic, because the processing scheme was though to have much slower performance. Advances in technology together with a new architectural approach make it feasible to also explore the computing technique for real-time track finding thus giving the advantages of implementing algorithms that can find more parameters such as calculate the sagitta, curvature, pt, etc. with respect to the CAM approach. This report describes real-time track finding using a new computing approach technique based on the 3D-flow array processor system. This system consists of a fixed interconnection architexture scheme, allowing flexible algorithm implementation on a scalable platform. The 3D-Flow parallel processing system for track finding is scalable in size and performance by either increasing the number of processors, or increasing the speed or else the number of pipelined stages. The present article describes the conceptual idea and the design stage of the project.

22414 (SSCL-SR–1225, pp. 629-631) **Data driven processor 'Vertex Trigger' for B experiments.** Hartouni, E.P. (Univ. of Massachusetts, Amherst, MA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Data Driven Processors (DDP's) are specialized computation engines configured to solve specific numerical problems, such as

vertex reconstruction. The architecture of the DDP which is the subject of this talk was designed and implemented by W. Sippach and B.C. Knapp at Nevis Lab. in the early 1980's. This particular implementation allows multiple parallel streams of data to provide input to a heterogenous collection of simple operators whose interconnection form an algorithm. The local data flow control allows this device to execute algorithms extremely quickly provided that care is taken in the layout of the algorithm. I/O rates of several hundred megabytes/second are routinely achieved thus making DDP's attractive candidates for complex online calculations. The original question was 'can a DDP reconstruct tracks in a Silicon Vertex Detector, find events with a separated vertex and do it fast enough to be used as an online trigger?' Restating this inquiry as three questions and describing the answers to the questions will be the subject of this talk. The three specific questions are: (1) Can an algorithm be found which reconstructs tracks in a planar geometry and no magnetic field; (2) Can separated vertices be recognized in some way; (3) Can the algorithm be implemented in the Nevis-UMass and DDP and execute in 10-20 μs?

22415 (SSCL-SR–1225, pp. 633-634) **Report of the trigger processor subgroup.** Johnson, M. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This is a summary report of a small group of people who met one afternoon to discuss trigger processors. The trigger processor group spent much of its time discussing new architecture's for high rate experiments. There was an attempt to differentiate between data driven architectures and the more conventional systems where triggers are divided into a series of levels. This was not too successful because most people felt that there were elements of the data driven architecture in almost all trigger systems – particularly at the front end. There are, however, broad divisions that are present in almost every trigger system. The typical trigger levels are defined as: level 1 - This is the section of the trigger that is truly dead timeless. The data is pipelined with enough buffers so that no crossing (event in fixed target) is lost. A trigger decision is generated at every crossing (but delayed by the length of the pipeline); level 3 - Processor farm with one complete event per processor; level 2 - Everything in between.

22416 (SSCL-SR–1225, pp. 707-711) **Comparison of forward and central collider detectors for beauty physics.** Kennedy, C.J. (Yale Univ., New Haven, CT (United States)); Harr, R.F.; Karchin, P.E. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A comparison of geometry, tracking, and muon triggering indicates that a central detector has a higher efficiency than a forward detector of equal psuedo rapidity coverage at both Tevatron and SSC energies. The difference at the Tevatron is considerable, about a factor of four. At the SSC, however, the difference is about a factor of two, so other considerations such as vertexing, particle ID, or cost may make a large forward detector an attractive option.

22417 (UCRL-CR–117195) **"24/36/48" Cathode Strip Chamber layout for SSC GEM Detector muon subsystem.** Belser, F.C. (and others); Clements, J.W.; Horvath, J.A. Lawrence Livermore National Lab., CA (United States). 15 Dec 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (GEM/TN–93-518). Order Number DE94012676. Source: OSTI; NTIS; INIS; GPO Dep.

The "48/48/48" ϕ-segmentation design for the Cathode Strip Chambers in the GEM Detector produces a number of coverage "gaps" in ϕ and θ. A revised "24/36/48" ϕ-segmentation layout provides increased geometric coverage and a significant reduction in the number of chambers in the detector. This will increase physics performance while reducing the labor costs associated with building and installing chambers in the GEM Detector. This paper documents the physical layout of the proposed change to the baseline chamber arrangement.

22418 (UCRL-JC–114619) **Gaseous effluent monitoring and identification using an imaging Fourier transform spectrometer.** Carter, M.R.; Bennett, C.L.; Fields, D.J.; Hernandez, J. Lawrence Livermore National Lab., CA (United States). Oct 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9310164–11: International symposium on substance identification technologies, Innsbruck (Austria), 4-8 Oct 1993). Order Number DE94012627. Source: OSTI; NTIS; GPO Dep.

We are developing an imaging Fourier transform spectrometer for chemical effluent monitoring. The system consists of a 2-D infrared imaging array in the focal plane of a Michelson interferometer. Individual images are coordinated with the positioning of a moving mirror in the Michelson interferometer. A three dimensional data cube with two spatial dimensions and one interferogram dimension is then Fourier transformed to produce a hyperspectral data cube with one spectral dimension and two spatial dimensions. The spectral range of the instrument is determined by the choice of optical components and the spectral range of the focal plane array. Measurements in the near UV, visible, near IR, and mid-IR ranges are possible with the existing instrument. Gaseous effluent monitoring and identification measurements will be primarily in the "fingerprint" region of the spectrum, (λ = 8 to 12 μm). Initial measurements of effluent using this imaging interferometer in the mid-IR will be presented.

22419 (UCRL-JC–115368) **Calculation of peak-to-total ratios for GE detector spectra.** Gunnink, R. (Lawrence Livermore National Lab., CA (United States)); De Corte, F.; De Wispelaere, A.; Bossus, D.; van Sluijs, R.; Vervecken, D. Lawrence Livermore National Lab., CA (United States). 1 Mar 1994. 9p. Sponsored by Belgian National Science Fund (Belgium). DOE Contract W-7405-ENG-48. (CONF-940401–7: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94011640. Source: OSTI; NTIS; GPO Dep.

We have measured many peak-to-total gamma-ray detection ratios for germanium detectors, and have correlated the observed values with various parameters, such as gamma-ray energy, detector size, source-to-detector distance, and shielding. We have also observed an unexpected, pronounced, positive slope in the peak-to-total curve in the low-energy region of p-type detectors. To explain this observation, we have evidence that the "dead" layer is not completely dead but is capable of producing degraded pulses that contribute to the continuum of a spectrum.

22420 (UCRL-JC–116023) **Recent progress in single sided gamma-ray tomography.** Thoe, R.S. Lawrence Livermore National Lab., CA (United States). Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940449–10: Society of Photo-Optical Instrumentation Engineers conference on intelligent information systems, Orlando, FL (United States), 4-8 Apr 1994). Order Number DE94012673. Source: OSTI; NTIS; GPO Dep.

The use of scattered radiation for radiography has many potential advantages over conventional projection techniques: For high energy photons the scattering process strongly dominates all other processes. The intensity of scattered radiation is due directly to the electron density and highly insensitive to chemical composition. Finally, the use of scattered radiation allows the investigator to position the radiation source-on-the same side of the object as the detector. In this paper I will present some recent results of a set of measurements made with our uncollimated Compton backscattering tomography apparatus. This technique uses the Compton energy shift of scattered gamma rays to determine the scattering site. By measuring the spectrum of these scattered gamma rays it is then possible to determine the electron density of the object being investigated. I will give a brief description of the apparatus and present the results of numerous measurements made on a brass phantom with voids placed at various depths. These results imply that for this crude apparatus occlusions as small as one cubic millimeter may be located to an accuracy of about one millimeter at depths of about 15 millimeters in solid brass.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 22351

22421 (FNAL-TM–1866) **New radiation stable and long-lived plastic scintillator for the SSC.** Senchishin, V. (Inst. for Single Crystals, Kharkov (Ukraine)); Koba, V.; Korneeva, O. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94013521. Source: OSTI; NTIS; INIS; GPO Dep.

The study of the influence of the concentration of secondary flour, high concentrations of primary dopant, diffusion enhancer, and stabilizer, on radiation hardness is presented. It is concluded that the diffusion enhancing technique is the most powerful method for improving rad hardness. A new polystyrene scintillator which contains 2% pT and 0.02% POPOP and 20% diffusion enhancer and 0.02% stabilizer gave 91% of initial light output immediately after 3MRad in air. Data are presented that show that scintillator prepared form commercial polymer is more radiation hard and has greater light output than scintillator prepared from monomer. It is assumed that this difference is due to different molecular weight distributions. Some protocols for acceleration of aging (yellowing and crazing) are presented. It is shown that one of the main reasons for aging of plastic scintillators is residual monomer.

22422 (FNAL-TM–1867) **Development of radiation hard scintillators.** Markley, F. (Fermi National Accelerator Lab., Batavia, IL (United States)); Davidson, M.; Keller, J.; Foster, G.; Pla-Dalmau, A.; Harmon, J.; Biagtan, E.; Schueneman, G.; Senchishin, V.; Gustfason, H.; Rivard, M. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94013204. Source: OSTI; NTIS; INIS; GPO Dep.

The authors have demonstrated that the radiation stability of scintillators made from styrene polymer is very much improved by compounding with pentaphenyltrimethyltrisiloxane (DC 705 vacuum pump oil). The resulting scintillators are softer than desired, so they decided to make the scintillators directly from monomer where the base resin could be easily crosslinked to improve the mechanical properties. They can now demonstrate that scintillators made directly from the monomer, using both styrene and 4-methyl styrene, are also much more radiation resistant when modified with DC705 oil. In fact, they retain from 92% to 95% of their original light output after gamma irradiation to 10 Mrads in nitrogen with air annealing. When these scintillators made directly from monomer are compared with scintillators of the same composition made from polymer the latter have much higher light outputs. They commonly reach 83% while those made form monomer give only 50% to 60% relative to the reference, BC408. When oil modified scintillators using both p-terphenyl and tetraphenylbutadiene are compared with identical scintillators except that they use 3 hydroxy-flavone as the only luminophore the radiation stability is the same. However the 3HF system gives only 30% as much light as BC408 instead of 83% when both are measured with a green extended Phillips XP2081B phototube.

22423 (SAND–94-0533C) **A proposed SEU tolerant DRAM cell.** Agrawal, G.R. (Vanderbilt Univ., Nashville, TN (United States). Dept. of Electrical Engineering); Massengill, L.W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940726–10: 31. annual international nuclear and space radiation effects conference, Tucson, AZ (United States), 18-22 Jul 1994). Order Number DE94010758. Source: OSTI; NTIS; GPO Dep.

A novel DRAM cell technology consisting of an access transistor and a bootstrapped storage capacitor with an integrated breakdown diode is proposed. This design offers considerable resistance to single event cell hits. The information change packet is shielded from an SE hit by placing the vulnerable node in a self-compensating standby state. The proposed cell is comparable in size to a conventional DRAM cell, but simulations show an improvement in critical charge of two orders of magnitude.

22424 (SAND–94-0534C) **Single event mirroring and sense amplifier designs for enhanced SE tolerance of DRAMs.** Gulati, K. (Vanderbilt Univ., Nashville, TN (United States). Dept. of Electrical Engineering); Massengill, L.W. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940726–11: 31. annual international nuclear and space radiation effects conference, Tucson, AZ (United States), 18-22 Jul 1994). Order Number DE94010397. Source: OSTI; NTIS; INIS; GPO Dep.

This paper investigates the applicability of existing SRAM SEU hardening techniques to conventional CMOS cross-coupled sense amplifiers used in DRAM structures. We propose a novel SEU mirroring concept and implementation for hardening DRAMs to bitline hits. Simulations indicate a 24-fold improvement in critical charge during the sensing state using a 10K T-Resistor scheme and a 28-fold improvement during the highly susceptible high impedance state using 2pF dynamic capacitance coupling.

4404 Well Logging Instrumentation

Refer also to citation(s) 22065

22425 (PNL-SA–23149) **Calibration facilities for borehole and surface environmental radiation measurements.** Stromswold, D.C. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940401–10: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94013323. Source: OSTI; NTIS; INIS; GPO Dep.

Measuring radiation from contaminated soil and buildings is important in the cleanup of land areas and facilities. It provides the means for quantifying the amount of contamination and assessing the success of efforts to restore areas to acceptable conditions for public use. Instruments that measure in situ radiation from natural or radiochemically-contaminated earth formations must be calibrated in appropriate facilities to provide quantitative assessments of concentrations of radionuclides. For instruments that are inserted into boreholes, these calibration facilities are typically special models having holes for probe insertion and having sufficient size to appear radiometrically "infinite" in extent. The US Department of Energy (DOE) has such models at Hanford, Washington, and Grand Junction, Colorado. They are concrete cylinders having a central borehole and containing known, enhanced amounts of K, U, and Th for spectral gamma-ray measurements. Additional models contain U for calibrating neutron probes for fissile materials and total-count gamma-ray probes. Models for calibrating neutron probes for moisture measurements in unsaturated formations exist for steel-cased boreholes at Hanford and for uncased boreholes at the DOE's Nevada Test Site. Large surface pads are available at Grand Junction for portable, vehicle-mounted, or airplane-mounted spectral gamma-ray detectors.

4405 Thermal Instrumentation

Refer also to citation(s) 21253

4406 Optical Instrumentation

Refer also to citation(s) 20679, 21120, 21190, 21921, 22203, 22350, 22440, 22599, 22782

22426 (DOE/ER/61085–3) **Submicrometer fiber-optic chemical sensors: Measuring pH inside single cells: Progress report, October 1990–August 1993.** Kopelman, R. Michigan Univ., Ann Arbor, MI (United States). [1993]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61085. Order Number DE94004160. Source: OSTI; NTIS; GPO Dep.

Starting from scratch, we went in two and a half years to 0.04 micron optical microscopy resolution. We have demonstrated the application of near-field scanning optical microscopy to DNA samples and opened the new fields of near-field scanning spectroscopy and submicron opto- chemical sensors. All of these

developments have been important steps towards in-situ DNA imaging and characterization on the nanoscale. Our first goal was to make NSOM (near-field scanning optical microscopy) a working enterprise, capable of "zooming-in" towards a sample and imaging with a resolution exceeding that of traditional microscopy by a factor of ten. This has been achieved. Not only do we have a resolution of about 40 nm but we can image a 1 × 1 micron object in less than 10 seconds. Furthermore, the NSOM is a practical instrument. The tips survive for days or weeks of scanning and new methods of force feedback will soon protect the most fragile samples. Reproducible images of metal gratings, gold particles, dye balls (for calibration) and of several DNA samples have been made, proving the practicality of our approach. We also give highly resolved Force/NSOM images of human blood cells. Our second goal has been to form molecular optics (e.g., exciton donor) tips with a resolution of 2–10 nm for molecular excitation microscopy (MEM). We have produced such tips, and scanned with them, but only with a resolution comparable to that of our standard NSOM tips. However, we have demonstrated their potential for high resolution imaging capabilities: (1) An energy transfer (tip to sample) based feedback capability. (2) A Kasha (external heavy atom) effect based feedback. In addition, a novel and practical optochemical sensor that is a billion times smaller than the best ones available has been developed as well. Finally, we have also performed spatially resolved fluorescence spectroscopy.

22427 (SAND–94-1189C) **Portable Doppler interferometer system for shock diagnostics and high speed motion.** Fleming, K.J.; Crump, O.B. Jr. Sandia National Labs., Albuquerque, NM (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–10: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011426. Source: OSTI; NTIS; GPO Dep.

VISAR (Velocity Interferometer System for Any Reflector) is a system that uses the Doppler effect and is widely used for measuring the velocity of projectiles, detonations, flying plates, shock pressures (particle velocity) and other high speed/high acceleration motion. Other methods of measurement such as accelerometers and pressure gauges have disadvantages in that they are sensitive to radiation, electromagnetic pulses, and their mass can drastically alter the velocity of the projectile. VISAR uses single frequency-single mode laser fight focused onto a target of interest. Reflected fight from the target is collected and sent through a modified, unequal leg Michelson interferometer. In the interferometer the light is split into two components which travel through the legs of the interferometer cavity and are then recombined. When the light recombines, an interference pattern is created which can range from dark (destructive interference) to bright (constructive interference). When the target moves, the reflected laser light experiences a frequency shift (increase) with respect to the frequency from the target in a static condition. Since the Doppler shifted light is split and routed through an unequal leg interferometer cavity, there is a time lag of the light containing the Doppler information at the recombination point in the interferometer. The effect of the time lag is to create a sinusoidally changing interference pattern (commonly called fringes). Since the interferometer time delay, laser wavelength, and the speed of light are known, an accurate measurement of target velocity/acceleration may be measured by analyzing both the number of tinges and the speed of tinge generation (system accuracy is 3–4%).

22428 (UCRL-JC–115106) **Adaptive optics at Lick Observatory: System architecture and operations.** Brase, J.M. (and others); An, J.; Avicola, K. Lawrence Livermore National Lab., CA (United States). Mar 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940391–8: Society of Photo-Optical Instrumentation Engineers (SPIE) conference, Kona Beach, HI (United States), 13-18 Mar 1994). Order Number DE94012387. Source: OSTI; NTIS; GPO Dep.

We will describe an adaptive optics system developed for the 1 meter Nickel and 3 meter Shane telescopes at Lick Observatory. Observing wavelengths will be in the visible for the 1 meter telescope and in the near IR on the 3 meter. The adaptive optics system design is based on a 69 actuator continuous surface deformable mirror and a Hartmann wavefront sensor equipped with an intensified CCD framing camera. The system has been tested at the Cassegrain focus of the 1 meter telescope where the subaperture size is 12.5 cm. The wavefront control calculations are performed on a four processor single board computer controlled by a Unix-based system. We will describe the optical system and give details of the wavefront control system design. We will present predictions of the system performance and initial test results.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 21278, 22506, 22532, 22778

22429 (DOE/ER/13749–T2) **[Investigation of ultrasonic surface wave interaction with porous saturated rocks]: Progress report, [July 1, 1993–June 30, 1994].** Ohio State Univ. Research Foundation, Columbus, OH (United States). [1994]. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13749. Order Number DE94013378. Source: OSTI; NTIS; GPO Dep.

Calculations showed that capillary forces can easily produce closed- pore boundary conditions at interface between nonwetting fluid (air) and a porous solid saturated by a wetting fluid (water). The direct excitation technique was used to measure surface wave velocity and attenuation on both wet and dry rocks. The strong correlation between the observed surface wave velocity change caused by water saturation and the formation permeability can be used for ultrasonic assessment of the dynamic permeability. The experimental system was improved further by introducing laser interferometric detection, which was adapted to surface wave inspection of fluid-saturated permeable materials. In a separate effort, the surface stiffness of different water-saturated porous solids was studied by a novel acoustical method. Areas for further study are described.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 20649, 20685, 20688, 21042, 21211, 21717, 21922, 22050, 22062, 22165, 22190, 22198, 22215, 22241, 22564, 22568, 22662

22430 (CONF-940766–1) **Determination of interface structure and bonding at atomic resolution in the stem.** Pennycook, S.J.; McGibbon, A.J.; McGibbon, M.M.; Browning, N.D.; Chisholm, M.F.; Jesson, D.E. Oak Ridge National Lab., TN (United States). Mar 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 13. international congress on electron microscopy; Paris (France); 17-22 Jul 1994. Order Number DE94011466. Source: OSTI; NTIS; GPO Dep.

The scanning transmission electron microscope now routinely produces probes of atomic dimensions, 2.2Å at 100 kV and 1.3Å at 300 kV. This capability opens up a new strategy for determining the structure and bonding of materials at the atomic scale, which is particularly advantageous for complex interfaces such as grain boundaries. The Z-contrast image allows the high-Z column locations to be determined by direct inspection, and quantified through maximum entropy methods to a positional accuracy of currently ~0.2Å. With the same electron probe, located to sub-Angstrom precision with reference to the Z-contrast image, parallel detection EELS can determine light element coordination from core edge fine structure, in principle around a single atomic column. There are several attractive features to combining Z-contrast imaging with EELS. First, the incoherent nature of Z-contrast imaging provides higher resolution, compared with 0.66 for phase contrast imaging, freedom from contrast reversals and a highly local image. This allows a greatly extended regieme of intuitive image interpretation. For example, the presence of dumbbells, with a spacing of 1.36Å, in a Si<110> image is seen directly at 2.2Å resolution from the elongation of the image features. For microanalysis, the Z-contrast image facilitates the accurate placement of the probe over selected atomic columns, either a single atomic column or using a line scan to reduce the effects of beam damage. Column-by-column analysis

by EELS is possible, without beam broadening, through the columnar channeling effect that occurs when a highly convergent coherent probe is incident along a low order crystal zone axis.

22431 (DOE/CE/15566–T2) **A Charge Distribution Analysis instrument for catalysis and material science applications: Second quarterly technical progress report, January 1, 1994–March 31, 1994.** Freund, F.; Plombon, J.J. Phytron Instruments, Inc., Mountain View, CA (United States). 9 May 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG49-93CE15566. Order Number DE94011587. Source: OSTI; NTIS; GPO Dep.

The instrument has four basic components: OEM analytical balance, pivot point and capacitor plates for sensing and controlling the position of the long inverted pendulum, gas confinement tower and high voltage bias electrodes, and furnace. Work during the second quarter has resulted in detailed design of the pivot point and capacitive sensing and control assembly to be attached onto the platen of a Denver Instruments A-series analytical balance.

22432 (DOE/PC/90284–13) **Molecular accessibility in solvent swelled coals: Final report.** Kispert, L.D. Alabama Univ., University, AL (United States). Dept. of Chemistry. Apr 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90284. Order Number DE94012170. Source: OSTI; NTIS; GPO Dep.

The conversion of coal by an economically feasible catalytic method requires the catalyst to diffuse into the coal sample so that hydrogenation catalysis can occur from within as well as the normal surface catalysis. Thus an estimate of the size, shape, and reactivity, of the pores in the coal before and after the swelling with different solvents is needed so that an optimum sized catalyst will be used. This study characterizes the accessible area found in Argonne Premium Coal Samples (APCS) using a EPR spin probe technique. The properties deduced in this manner correlate well with the findings deduced from SANS, NMR, SEM, SAXS and light scattering measurements. The use of nitroxide spin probes with swelling solvents is a simple way in which to gain an understanding of the pore structure of coals, how it changes in the presence of swelling solvents and the chemistry that occurs at the pore wall. Hydrogen bonding sites occur primarily in low-rank coals and vary in reactive strength as rank is varied. Unswelled coals contain small, spherical pores which disappear when coal is swelled in the presence of polar solvents. Swelling studies of polystyrene-divinyl benzene copolymers implied that coal is polymeric, contains significant quantities of covalent cross-links and the covalent cross-link density increases with rank.

22433 (DOE/PC/92521–T148) **Vhf EPR quantitation and speciation of organic sulfur in coal: [Quarterly] technical report, December 1, 1993–February 28, 1994.** Clarkson, R.B. (Illinois Univ., Urbana, IL (United States)); Belford, R.I. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE94012575. Source: OSTI; NTIS; GPO Dep.

The existence of free electrons in coals' natural site offers a great attraction for Electron Paramagnetic Resonance (EPR) analysis to aid in the study of the structure and composition of coal. This direct and non-destructive approach to coal analysis has been hindered by the problem of resolution using the conventional 9.5 GHz EPR spectrometers. In the past few years, we have developed techniques including W-band Very High Frequency EPR spectroscopy as a means of determining the quantity and structure of organic sulfur in native and desulfurized coals. The state of the art 95 GHz (W-band) EPR spectrometer which we have constructed shows a well resolved spectrum including the interaction between unpaired electrons and the heteroatom like sulfur. The spectra also provide quantitative as well as qualitative information regarding different sulfur species. In collaboration with researchers at the University of Kentucky, we are also analyzing the result of desulfurization techniques on the presence of various sulfur species in coal. In the past, we have tried to synthesize various model compounds comparing their W-band spectra with other models, the predictions of theoretical models, and with the W-band spectra of coal specimens. In this quarter, we have been concentrating our efforts on developing a new standard protocol in handling and preparing the coal samples for EPR measurements to provide a quantitative comparison between the EPR spectra of coal in the natural state and desulfurized. Ten coal samples, both native and desulfurized, have been provided to us. These samples have been run in both laboratories. The simulation of coal EPR spectra has been carried out using several mathematical models. EPR results now are being compared with XANES data.

22434 (INIS-BR–3331) **Development of a nuclear precession magnetometer.** Virgens Alves, J.G. das. Para Univ., Belem, PA (Brazil). Curso de Pos-graduacao em Ciencias Geofisicas e Geologicas. Dec 1983. 123p. (In Portuguese). Order Number DE94626493. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this thesis was to develop a proton precession magnetometer for geophysical prospecting and base stations. The proton procession magnetometer measures the total magnetic fields intensity. It operates on the basis of nuclear magnetic resonance by determining the processing frequency of protons of a non viscous liquid in the terrestrial magnetic fields. The instrument was tested in field to evaluate signal/noise ratio, supportable gradient and battery consumption. Application test was carried out to take diurnal variation data and, reconnaissance and detail surveys data on an archaeological site in the Marajo Island-Pa. The test results were confronted with two commercial magnetometers-GP-70, McPhar e G-816, Geometric - and, with data from Observatorio Magnetico Ilha de Tatuoca as well. For all cases, the data comparison showed a good performance of the magnetometer tested. (author).

22435 (LBL–35474) **Charge collection in a-Si:H/a-$Si_{1-x}C_x$ multilayers photodetectors.** Jing, T. (Lawrence Berkeley Lab., CA (United States)); Drewray, J.; Hong, W.S.; Lee, H.; Kaplan, S.N.; Mireshghi, A.; Perez-Mendez, V.; Delgado, J.C.; Bertomeu, J. Lawrence Berkeley Lab., CA (United States). Apr 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9404171–1: 2. international conference on thin film physics and applications, Shanghai (China), 14-17 Apr 1994). Order Number DE94013107. Source: OSTI; NTIS; INIS; GPO Dep.

Amorphous semiconductors have been used as thin film transistor(TFT), solar cell, phototransistors. In this paper we study the charge collected properties of a-Si:H/a-$Si_{1-x}C$:H_x multilayer pin photodiode. In a-Si:H pin photodiode, the photogenerated carriers can be totally collected under strong electric field under reverse bias. However, our measurements show that in the a-Si:H/a-$Si_{1-x}C$:H_x multilayer pin photodiode photogenerated electrons and holes drift toward the electrodes under a certain bias, the total collected charge shows no saturation with bias and exhibits a continuous increase with reverse bias. We classify that the device works at two regions. In Region 1, the device behaves like a photodiode. This charge collection efficiency drop from theoretical value may indicate charge capture or confinement at the interfaces and trapping at the a-Si:H potential wells. These charges trapped or confined can be released at the interface and quantum well at higher electric field. In Region 2, above a critical bias voltage, the device works as a breakdown diode with a series photosensitive resistor which contributes higher collection efficiency, namely optical gain greater than unity.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 21120, 21121, 21608, 22225, 22783

22436 (LA-SUB–93-179) **The future of nonnuclear strategic weapons: Final summary report.** Brody, R. (Pan Heuristics, Marina del Rey, CA (United States)); Digby, J. Los Alamos National Lab., NM (United States); Pan Heuristics, Marina del Rey, CA (United States). 31 Jan 1989. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012079. Source: OSTI; NTIS; GPO Dep.

In this brief study, Pan Heuristics (PAN) has (1) evaluated the future importance of nonnuclear strategic weapons (NNSW), (2)

considered their impact on forces and operations, and (3) investigated the technical requirements to support NNSW. In drawing conclusions, PAN has emphasized aspects that might be important to Los Alamos National Laboratory over the long run. It presents them here in a format similar to that used in a briefing at the laboratory. This paper reflects independent PAN research as well as conclusions drawn from discussions with other offices and individuals involved in nonnuclear strategic weapons development.

22437 (LA-UR–94-861) **Nonlethal weapons as force options for the Army.** Alexander, J.B. Los Alamos National Lab., NM (United States). [1994]. 10p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9403104–1: National Research Council Board symposium on Army science and technology, Washington, DC (United States), 28-29 Mar 1994). Order Number DE94009311. Source: OSTI; NTIS; GPO Dep.

This paper suggests that future challenges to US national security will be very different from those previously experienced. In a number of foreseeable circumstances, conventional military force will be inappropriate. The National Command Authority, and other appropriate levels of command, need expanded options available to meet threats for which the application of massive lethal force is counterproductive or inadvisable. It is proposed that nonlethal concepts be developed that provide additional options for military leaders and politicians. Included in this initiative should be exploration of policy, strategy, doctrine, and training issues as well as the development of selected technologies and weapons. In addition, civilian law enforcement agencies have similar requirements for less-than-lethal systems. This may be an excellent example for a joint technology development venture.

22438 (SAND–94-0258) **Production Capability Assurance Program (PCAP) data base support process/procedures and roles/responsibilities.** Flores, P.; Griego, L.; Weeks, J. Sandia National Labs., Albuquerque, NM (United States). Apr 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013457. Source: OSTI; NTIS; GPO Dep.

This document presents a set of proposed business process and procedures in support of the Production Capability Assurance Program (PCAP) Data Base. These processes and procedures have been adopted by the DOE Albuquerque Weapon Quality Division. Section 1 presents processes and procedures. The procedures support the PCAP Data Base. These procedures fall into the following three (3) categories: Input, Administrative, and Maintenance. Each process has supporting procedures that clearly define the effort to support the PCAP Data Base. The Input category consists of data receipt, data entry, and entry verification and validation. Data entry is entering data that has been received in either a magnetic or hard copy form. Entry verification and validation communicates results of data entry back to the data source. The Administrative category includes change control, access control, coordination of data base and system errors or problems, and coordination of data base and system enhancements. Access control addresses the issues of granting access to the PCAP data base and access to specific functionality such as: update, delete, and specific report initiation. The Maintenance category includes both hardware and software maintenance, data archival and restoration, and the correction of both major and minor software and system problems. Data archival and restoration consists of backing up of the data base and, if necessary, the loading of the data base from archival media in the event of a system disaster. Section 2 defines the roles and responsibilities associated with the processes/procedures. There are four (4) roles: System Administration, Data Base Administration, System Maintenance, and Data Base Maintenance.

22439 (SAND–94-0335) **Radiant heat testing of the H1224A shipping/storage container.** Harding, D.C.; Bobbe, J.G.; Stenberg, D.R.; Arviso, M. Sandia National Labs., Albuquerque, NM (United States). May 1994. 219p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. (TIC–1299). Order Number DE94012140. Source: OSTI; NTIS; GPO Dep.

H1224A weapons containers have been used for years by the Departments of Energy and Defense to transport and store W78 warhead midsections. Although designed to protect the midsections only from low-energy impacts, a recent transportation risk assessment effort has identified a need to evaluate the container's ability to protect weapons in more severe accident environments. Four radiant heat tests were performed: two each on an H1224A container (with a Mk12a Mod 6c mass mock-up midsection inside) and two on a low-cost simulated H1224A container (with a hollow Mk12 aeroshell midsections inside). For each unit tested, temperatures were recorded at numerous points throughout the container and midsection during a 4-hour 121°C (250°F) and 30-minute 1010°C (1850°F) radiant environment. Measured peak temperatures experienced by the inner walls of the midsections as a result of exposure to the high-temperature radiant environment ranged from 650° C to 980° C (1200° F to 1800°F) for the H1224A container and 770 ° to 990 °C (1420° F to 1810°F) for the simulated container. The majority of both containers were completely destroyed during the high-temperature test. Temperature profiles will be used to benchmark analytical models and predict warhead midsection temperatures over a wide range of the thermal accident conditions.

22440 (SAND–94-0689C) **A Highly Agile Ground Assessment Robot (HAGAR) for military battlefield and support missions.** Klarer, P. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–11: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008941. Source: OSTI; NTIS; GPO Dep.

A mobile robotic vehicle with potential for use in military field applications is described. Based on a Sandia design intended for use in exploration of the Lunar surface, the Highly Agile Ground Assessment Robot (HAGAR) is a four wheeled all-wheel-drive dual-body vehicle. A uniquely simple method of chassis articulation is employed which allows all four wheels to remain in contact with the ground, even while operating in very rough terrain and climbing over obstacles as large as a wheel diameter. Skid steering and modular construction are used to produce a simple, rugged, lightweight, highly agile mobility chassis with a reduction in the number of parts required when compared to conventional vehicle designs for military battlefield and support missions. The design configuration, mobility parameters, potential mission configurations, and performance of existing and proposed HAGAR prototypes are discussed.

22441 (SAND–94-0766) **A more exact analysis of Sandia Laser Tracker data.** Phipps, G.S. Sandia National Labs., Albuquerque, NM (United States). May 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011411. Source: OSTI; NTIS; GPO Dep.

The Sandia Laser Tracker (LT) systems illuminate a cooperative target with a diverged Argon-ion laser beam and track the resulting bright target using a servo-controlled turning mirror. Raw data is digitally recorded in real time and analyzed later when more time is available. The recorded data consists of azimuth and elevation of the tracking mirror, tracking error signals, and range to the target. If the target is tracked perfectly, the error signals will always be zero. The data reduction for this simplified, zero-error condition can be accomplished with very few lines of code. To date, all data reduction for LTI has been done using this zero-error assumption. The more general data reduction problem using the tracking error signals is a much more involved calculation and is referred to as "using the error foldback routine." Detailed theory and vector analysis behind the data reduction and error decoupling algorithms used in the LT systems are described. Errors and corrections to the original document uncovered in over ten years of use are also noted and corrected.

22442 (SAND–94-0767C) **The Surveillance And Reconnaissance Ground Equipment (SARGE), real robots for real soldiers.** Pletta, J.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–10: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008954. Source: OSTI; NTIS; GPO Dep.

The Joint Program Office for Unmanned Ground Vehicles and Sandia National Laboratories are developing the Surveillance And Reconnaissance Ground Equipment (SARGE) robot. The SARGE system is a second generation refinement of Sandia's Dixie robot. A comparison of Dixie's actual performance and the expected SARGE performance characteristics will be given. The SARGE design philosophy embraces proven technology, low power consumption, and modular sensor packages designed to meet specific mission needs. A major aspect of the SARGE program is obtaining user acceptance through ownership of the prototype hardware. A total of ten systems are being fabricated with at least eight being given to infantry battalions for their use in day to day operations. The SARGE robot is a prototype system that is not intended to meet all the needs of the infantry soldier but will provide a reliable platform which will enable the soldier to determine first hand the required capabilities for future unmanned ground vehicles on the battlefield.

22443 (UCRL-JC–117194) **Shielding and criticality requirements in the transport of special nuclear materials.** Hansen, L.F.; Pearson, J.S. Lawrence Livermore National Lab., CA (United States). May 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940507–9: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012385. Source: OSTI; NTIS; GPO Dep.

Shielding and criticality issues related to the transport of special radioactive assemblies and nuclear weapons are discussed, together with the need for detailed information on the geometry and material composition of the packaging and radioactive load, energy distribution of the neutron and gamma spectra emitted from this load, and the nuclear cross sections and transport codes used, in order to calculate the dose rates outside the package and to assure that it will remain sub critical under normal or accident conditions of transport. The need for compliance with dose rate values and criticality criteria imposed by the code of federal regulations (CFR) and implemented by DOE is also discussed.

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Refer also to citation(s) 20737, 22232, 22460, 22462, 22463

22444 (DOE/RL–93-84) **Explosives Classifications Tracking System User Manual.** Genoni, R.P. USDOE Richland Operations Office, WA (United States). Oct 1993. 58p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94011331. Source: OSTI; NTIS; GPO Dep.

The Explosives Classification Tracking System (ECTS) presents information and data for U.S. Department of Energy (DOE) explosives classifications of interest to EM-561, Transportation Management Division, other DOE facilities, and contractors. It is intended to be useful to the scientist, engineer, and transportation professional, who needs to classify or transport explosives. This release of the ECTS reflects upgrading of the software which provides the user with an environment that makes comprehensive retrieval of explosives related information quick and easy. Quarterly updates will be provided to the ECTS throughout its development in FY 1993 and thereafter. The ECTS is a stand alone, single user system that contains unclassified, publicly available information, and administrative information (contractor names, product descriptions, transmittal dates, EX-Numbers, etc.) information from many sources for non-decisional engineering and shipping activities. The data is the most up-to-date and accurate available to the knowledge of the system developer. The system is designed to permit easy revision and updating as new information and data become available. These, additions and corrections are welcomed by the developer. This user manual is intended to help the user install, understand, and operate the system so that the desired information may be readily obtained, reviewed, and reported.

22445 (DOE/RL–94-45) **Multipurpose explosive (MPX) drum-shaped packaging design criteria.** USDOE Richland Operations Office, WA (United States). May 1994. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94013579. Source: OSTI; NTIS; GPO Dep.

In fiscal year 1993, the Transportation Management Division of the US Department of Energy sponsored an engineering study, completed by Westinghouse Hanford Company, to examine the viability of a generic packaging design able to satisfy multiple explosives packaging needs. Engineering study results indicated that a box-shaped and drum-shaped (allowable outer packaging shapes) multipurpose explosive (MPX) packaging would mitigate the impact of US Department of Transportation (DOT) Docket HM-181. The MPX packaging concept was for a multi-modal, reusable outer packaging to facilitate the transport of prepackaged solid explosives, most of which are in obsolete pre-HM-181 specification packagings, inside of the MPX packaging. This document sets forth the design criteria for the drum-shaped MPX packaging. These design criteria delineate minimum functional and regulation mandated requirements for the MPX drum-shaped packaging. Functional requirements are derived from US Department of Energy site personnel involved in explosives manufacturing and shipping. Regulatory requirements are derived from DOT and International Air Transport Association transport regulations, enabling the MPX packaging to be used by commercial carriers in either highway or air transportation modes.

22446 (LA-UR–94-1183) **Computational analysis of azine-N-oxides as energetic materials.** Ritchie, J.P. Los Alamos National Lab., NM (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940301–33: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994). Order Number DE94011652. Source: OSTI; NTIS; GPO Dep.

A BKW equation of state in a 1-dimensional hydrodynamic simulation of the cylinder test can be used to estimate the performance of explosives. Using this approach, the novel explosive 1,4-diamino-2,3,5,6-tetrazine-2,5-dioxide (TZX) was analyzed. Despite a high detonation velocity and a predicted CJ pressure comparable to that of RDX, TZX performs relatively poorly in the cylinder test. Theoretical and computational analysis shows this to be the result of a low heat of detonation. A conceptual strategy is proposed to remedy this problem. In order to predict the required heats of formation, new ab initio group equivalents were developed. Crystal structure calculations are also described that show hydrogen-bonding is important in determining the density of TZX and related compounds.

22447 (LA-UR–94-1540) **Metastable Interstitial Composites: Super thermite powders.** Aumann, C.E.; Martin, J.A.; Skofronick, G.L.; Murray, A.S. Los Alamos National Lab., NM (United States). 8 Jun 1994. 23p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9406106–3: Insensitive munitions technology symposium, Williamsburg, VA (United States), 6-9 Jun 1994). Order Number DE94013248. Source: OSTI; NTIS (US Sales Only); GPO Dep.

MICs, a new concept in synthesis of energetic materials, are tunable in both reactive power and ignition sensitivity. Thin film and bulk analogs of MICs have been produced that can achieve reactive powers 1000× that of thermite. By adjusting the average separation distance between reactive components, the specific power can be tuned over a wide range. Although mixtures of ultrafine Al and MoO_3 powders are very easily ignited by spark, they can be desensitized in two ways: post-oxidation of the as-prepared Al powders which thickens the protective oxide shell of each Al particle (this is practical only for low specific powers), or mixing insensitive mixtures of Al/Teflon with sensitive mixtures of Al/MoO_3.

22448 **Selectable fragmentation warhead.** Bryan, C.S.; Paisley, D.L.; Montoya, N.I.; Stahl, D.B. To Dept. of Energy. [1992]. Filed date 27 Mar 1992. U.S. Patent Application 7-858,744. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94010169. Source: OSTI; NTIS; GPO Dep.

This report discusses a selectable fragmentation warhead which is capable of producing a predetermined number of fragments from a metal plate, and accelerating the fragments toward a target. A first explosive located adjacent to the plate is detonated at selected

number of points by laser-driven slapper detonators. In one embodiment, a smoother-disk and a second explosive, located adjacent to the first explosive, serve to increase acceleration of the fragments toward a target. The ability to produce a selected number of fragments allows for effective destruction of a chosen target.

22449 (SAND–94-0336C) **BNCP prototype detonator studies using a semiconductor bridge initiator.** Fyfe, D.W. (Pacific Scientific Co., Avondale-Goodyear, AZ (United States). Energy Dynamics Div.); Fronabarger, J.W.; Bickes, R.W. Jr. Sandia National Labs., Albuquerque, NM (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940776–2: 20. international pyrotechnics seminar, Colorado Springs, CO (United States), 25-29 Jul 1994). Order Number DE94012725. Source: OSTI; NTIS; GPO Dep.

We report on experiments with prototype BNCP detonators incorporating a semiconductor bridge, SCB. We tested two device designs; one for DoD and one for DOE applications. We report tests with the DoD detonator using different firing conditions and two different grain sizes of BNCP. The DOE detonator utilized a 50 μF CDU firing set with a 24 V all-fire condition.

22450 (SAND–94-0363C) **A constitutive mechanical model for energetic materials.** Hobbs, M.L.; Baer, M.R.; Gross, R.J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940776–4: 20. international pyrotechnics seminar, Colorado Springs, CO (United States), 25-29 Jul 1994). Order Number DE94013794. Source: OSTI; NTIS; GPO Dep.

Cookoff modeling of energetic materials has traditionally addressed reactive heat flow with the goal of defining the onset of runaway combustion behavior. Current modeling efforts are now aimed toward predicting the violence of the event. Combined thermal, chemical, and mechanical response must be modeled, since confinement results in pressure buildup which can breach confinement or enhance gas-phase combustion rates leading to runaway combustion behavior. Thermally induced stresses can also cause gaps which inhibit heat flow. These mechanical effects must also be included in cookoff modeling. A new reactive elastic-plastic constitutive model for micromechanical response has been developed which represents a stress-strain relation for reacting materials such as explosives, propellants, pyrotechnics, or burning foams. This micromechanical model is based on bubble mechanics. A local force balance, with mass continuity constraints, forms the basis of the constitutive model requiring input of temperature and reacted fraction. This constitutive material model has been incorporated into a quasistatic mechanics code, SANTOS. To provide temperature and reacted gas fraction, the thermal-chemical solver, XCHEM, has been coupled to SANTOS. This paper summarizes the development of the micromechanical model with material property estimates for conventional energetic materials. This study shows that large pressures can arise from small reacted fractions which implies that cookoff modeling must consider the strong interaction between thermochemistry and mechanics.

22451 (SAND–94-0774C) **Prompt laser ignition and transition to detonation in a secondary explosive.** Setchell, R.E.; Trott, W.M. Sandia National Labs., Albuquerque, NM (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404141–1: 15. symposium on explosives and pyrotechnics, Philadelphia, PA (United States), 19-21 Apr 1994). Order Number DE94010760. Source: OSTI; NTIS; GPO Dep.

A two-stage approach to achieving detonation in a secondary explosive was developed in previous studies in which ignition resulted from low-energy hot wires or from laser diodes. In the current study, this approach was examined in some detail for the case of ignition by a pulsed, solid-state (rod) laser. An initial series of experiments used Nd/glass, ND/YAG, and Ti/sapphire lasers to investigate the ignition of graphite-doped HMX in highly confined optical fixtures that incorporated a fast piezoelectric pressure transducer. Experimental parameters included the laser power history and the explosive column length. The results of these experiments guided a second series of experiments in which the ignition column explosive was terminated by a thin rupture disc in contact with a transition column of low density HMX or some other material. The transition column was terminated with a piezoelectric time-of-arrival detector for determining overall function times. Parameters investigated included different laser sources, rupture disc thicknesses, and the transition column explosive characteristics. Overall function times less than 50 microseconds were obtained, and trends established by the various parameter studies indicate that further reductions in function time can be achieved.

22452 (SAND–94-1188C) **DDT modeling and shock compression experiments of porous or damaged energetic materials.** Baer, M.R.; Anderson, M.U.; Graham, R.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–6: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011419. Source: OSTI; NTIS; GPO Dep.

In this presentation, we present modeling of DDT in porous energetic materials and experimental studies of a time-resolved, shock compression of highly porous inert and reactive materials. This combined theoretical and experimental studies explore the nature of the microscale processes of consolidation, deformation and reaction which are key features of the shock response of porous or damaged energetic materials. The theoretical modeling is based on the theory of mixtures in which multiphase mixtures are treated in complete nonequilibrium allowing for internal boundary effects associated mass/momentum and energy exchange between phases, relative flow, rate-dependent compaction behavior, multistage chemistry and interphase boundary effects. Numerous studies of low-velocity impacts using a high resolution adaptive finite element method are presented which replicate experimental observations. The incorporation of this model into multi-material hydrocode analysis will be discussed to address the effects of confinement and its influence on accelerated combustion behavior. The experimental studies will focus on the use of PVDF piezoelectric polymer stress-rate gauge to precisely measure the input and propagating shock stress response of porous materials. In addition to single constituent porous materials, such as granular HMX, we have resolved shock waves in porous composite intermetallic powders that confirm a dispersive wave nature which is highly morphologically and material dependent. This document consists of viewgraphs from the poster session.

22453 (SAND–94-1190C) **Effects of two-phase flow on the deflagration of porous energetic materials.** Margolis, S.B. (Sandia National Labs., Livermore, CA (United States)); Williams, F.A. Sandia National Labs., Livermore, CA (United States). [1994]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–8: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011423. Source: OSTI; NTIS; GPO Dep.

The combustion behavior of energetic materials (e.g., solid propellants) has long been of interest in the fields of propulsion and pyrotechnics. In many such applications, it is becoming increasingly clear that two-phase flow effects play an important role, especially since, during combustion, most homogeneous solid propellants develop thin multi-phase layers at their surfaces in which finite-rate exothermic reactions occur. In addition, there is a growing interest in the behavior of porous energetic solids, since even initially dense materials can develop significant void fractions if, at any time, they are exposed to abnormal thermal environments. The deflagration characteristics of such "damaged" materials may then differ significantly from those of the pristine material due, at least in part, to gas flow in the solid/gas preheat region. The presence of gas in the porous solid in turn results in a more pronounced two-phase effect in the multi-phase surface layer, such as in the liquid melt region of nitramine propellants, which thus tend to exhibit extensive bubbling in an exothermic foam layer. The present analysis is largely applicable to this latter class of propellants.

22454 (SAND–94-1191C) **Thermal decomposition reactions of HMX and RDX and their importance in predicting cookoff hazards.** Behrens, R. Jr. (Sandia National Labs., Livermore, CA (United States)); Bulusu, S. Sandia National Labs., Livermore, CA

(United States). [1994]. 30p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–11: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011430. Source: OSTI; NTIS; GPO Dep.

Includes vugraphs.

To develop robust models for predicting the response of munitions under abnormal conditions associated with cookoff, it is necessary to be able to accurately characterize the following: the time to ignition, the location of the ignition point within the munition, and the combustive behavior of the damaged energetic material after ignition. For, the response of the munition, as controlled by these parameters, will determine whether its response will be characterized by a relatively mild deflagration or whether it will be characterized by a more damaging detonation. Several of the underlying properties of the energetic materials used in munitions that must be understood in order to accurately characterize these parameters are the chemical and physical changes that occur in these energetic materials as they are heated. The chemical changes involve overcoming the forces that tend to stabilize these materials, such as binding within the crystal lattice or intermolecular hydrogen bonding, and their transformation to less stable forms, such as mixtures of gases with high energy content. The physical changes typically involve phase changes of the material. One significant phase change is the slow transformation of the energetic materials from the solid reactant to gas phase products. This transformation can lead initially to the formation of high pressure gas bubbles within the solid particles and ultimately to changes in the porosity and gas permeability of the energetic material formulation. The presence of these reactive gases within high pressure bubbles can lead to increased hot spot formation of the material if it is compressed. The increased porosity can lead to significant increases in the burn rates of these materials at high pressures.

22455 (SAND–94-1197C) **A fully coupled thermal, chemical, mechanical cookoff model.** Hobbs, M.L.; Baer, M.R.; Gross, R.J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–2: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011432. Source: OSTI; NTIS; GPO Dep.

Cookoff modeling of confined energetic materials involves the coupling of thermal, chemical and mechanical effects. In the past, modeling has focussed on the prediction of thermal runaway with little regard to the effects of mechanical behavior of the energetic material. To address the mechanical response of the energetic material, a constitutive submodel has been developed which can be incorporated into thermal-chemical-mechanical analysis. This work presents development of this submodel and its incorporation into a fully coupled one-dimensional, thermal-chemical-mechanical computer code to simulate thermal initiation of energetic materials. Model predictions include temperature, chemical species, stress, strain, solid/gas pressure, solid/gas density, yield function, and gas volume fraction. Sample results from a scaled aluminum tube filled with RDX exposed to a constant temperature bath at 500 K will be displayed. The micromechanical submodel is based on bubble mechanics which describes nucleation, decomposition, and elastic/plastic mechanical behavior. This constitutive material description requires input of temperatures and reacted fraction of the energetic material as provided by the reactive heat flow code, XCHEM, and the mechanical response is predicted using a quasistatic mechanics code, SANTOS. A parametric sensitivity analysis indicates that a small degree of decomposition causes significant pressurization of the energetic material, which implies that cookoff modeling must consider the strong interaction between thermal-chemistry and mechanics. This document consists of view graphs from the poster session.

22456 (UCRL-ID–117155) **Lightning-resistant, low-inductance detonator cables.** Druce, R.L.; Lee, R.S.; Moua, K. Lawrence Livermore National Lab., CA (United States). Apr 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012474. Source: OSTI; NTIS; GPO Dep.

A lightning strike on a flat detonator cable in close proximity to a high explosive (HE) main charge poses a possible detonation hazard if the electrical explosion of the cable launches the dielectric cover coat of the cable at a high enough velocity to shock-initiate the HE. The detonator cable for the W87 system has been demonstrated to be incapable of initiating LX-17 main-charge explosive even for a 99 percentile negative lightning strike (1). The W87 cable is a relatively high inductance cable, unsuitable for use with low-inductance firesets. We have performed tests on a low-inductance cable designed for the W89 program, which show it to be marginal in its ability to withstand a lightning strike without the possibility of initiating a heated LX-17 main charge HE. A new cable design, proposed by R.E. Lee of LLNL has been tested and shown to be capable of withstanding a 99 percentile negative lightning strike without initiating LX-17 heated to 250°C.

22457 (UCRL-JC–115229) **Neutron interrogation to identify chemical elements with an ion-tube neutron source (INS).** Alvarez, R.A.; Dougan, A.D.; Rowland, M.R.; Wang, T.F. Lawrence Livermore National Lab., CA (United States). 7 Apr 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940401–6: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94011639. Source: OSTI; NTIS; GPO Dep.

A non-destructive analysis technique using a portable, electric ion-tube neutron source (INS) and gamma ray detector has been used to identify the key constituent elements in a number of sealed munitions, and from the elemental makeup, infer the types of agent within each. The high energy (14 MeV) and pulsed character of the neutron flux from an INS provide a method of measuring, quantitatively, the oxygen, carbon, and fluorine content of materials in closed containers, as well as the other constituents that can be measured with low-energy neutron probes. The broad range of elements that can be quantitatively measured with INS-based instruments provides a capability of verifying common munition fills; it provides the greatest specificity of any portable neutron-based technique for determining the full matrix of chemical elements in completely unrestricted sample scenarios. The specific capability of quantifying the carbon and oxygen content of materials should lead to a fast screening technique which, can discriminate very quickly between high-explosive and chemical agent-filled containers.

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Refer also to citation(s) 20816, 21083, 21904, 21905, 21906, 21907, 21908, 21909, 21910, 21911, 21912, 21913, 21914, 21915, 22189, 22193, 22529, 22560, 22594, 22678

22458 (DOE/FTR–94006599) **Travel to Europe for discussions on issues related to nuclear weaponry: Foreign trip report, December 8–18, 1993.** McCoy, D.L.; Bohrer, D.J.; Carlson, G.H. Los Alamos National Lab., NM (United States). 7 Feb 1994. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94006599. Source: OSTI; NTIS (US Sales Only); GPO Dep.

We were requested by Dr. David Parkes, Head of Engineering, Atomic Weapons Establishment to provide a review of the Air-Hydride issue and US implementation status and detection techniques. At EUCOM we discussed 3 subjects: (1) Action item status from the May 1993 visit; (2) Field Safety Technical Assistance (FIESTA) discussions; (3) NATO Host National Cost Reduction Study. At USAFE we discussed the first two OAKUM subjects and also provided a review of trainer options and operational concepts for use. At Buchel we discussed ways that DOE could help the AF implement the regional maintenance concept.

22459 (HW–64145) **Title list: Non-destructive testing of weapon components.** Winsor, R.V. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 3 Mar 1960. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012820. Source: OSTI; NTIS; GPO Dep.

Declassified.

This is a list of memorandums and reports from 1950 through 1959. Various methods for inspection of the metal parts are listed. Most of the reports referred to are either classified as secret or confidential. (GHH)

22460 (SAND–93-3896C) **Response of gas discharge tubes to the simulated follow-on currents of lighting strokes.** Field, C.S. III; Shapnek, L.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940531–1: International symposium on electromagnetic environments and consequences, Bordeaux (France), 30 May - 3 jun 1994). Order Number DE94011936. Source: OSTI; NTIS; GPO Dep.

This report describes the testing of various gas discharge tubes produced by Reynolds Industries, Inc., Los Angeles, California, to input current levels ranging from 50 to 1535 amperes for durations of 0.011 to 1.0 seconds. The gas discharge tubes are used in various Transient Limiter Modules (TLMs) by Department 9333-1 in field test applications to mitigate the effects of lightning and large electrical transients on components and systems. The current pulses described above represent, in amplitude and pulse width, the follow-on portion of lightning strokes encountered in nature. Our purposes in this test program were accomplished as follows: we established the failure thresholds and failure modes of various gas discharge tubes manufactured by Reynolds Industries in the simulated follow-on phase of lightning strokes; we characterized gaps with differing breakdown voltage levels, amperage ratings and electrode materials in this environment; we tested gaps in their TLM module configurations (both potted and unpotted) to follow-on lightning current levels; and we suggested methods to improve the energy-absorbing capabilities of gaps used in these applications. This work was performed by the authors at Reynolds Industries, Inc., Santa Maria, California, in August, 1991.

22461 (SAND–94-0525) **Vacuum cleaner modifications leading to reduced ESD hazards.** Jones, R.D.; Chen, K.C.; Holmes, S.W. Sandia National Labs., Albuquerque, NM (United States). Mar 1994. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011410. Source: OSTI; NTIS; GPO Dep.

After a series of meetings held in response to an Unsatisfactory Report on the use of vacuum cleaners, an experimental study of commonly available vacuum cleaners was conducted. The object of the study was to evaluate the effectiveness of the cleaners as electrostatic generators. The electrical charges generated by the machine can inadvertently be transferred in normal operations to electroexplosive devices (EEDs), thereby creating a potentially hazardous situation. In the course of this study, it was determined that many inexpensive commercial cleaners could be used safely providing certain modifications were made. Details of the required modification and rationale for the modification are presented in this report.

22462 (SAND–94-0929) **Primary Standards Laboratory report, 2nd half 1993.** Sandia National Labs., Albuquerque, NM (United States). May 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012994. Source: OSTI; NTIS; GPO Dep.

The Primary Standards Laboratory (PSL) operates a system-wide primary standards and calibration program for the US Department of Energy, Albuquerque Field Office (DOE/AL). The PSL mission is as follows: to develop and maintain primary standards; to calibrate electrical, physical, and radiation reference standards for customer laboratories (DOE/AL nuclear weapon contractors); to conduct the technical surveys and measurement audits of these laboratories; and to recommend and implement system-wide improvements. This report summarizes activities of the PSL for the second half of 1993 and provides information pertinent to the operation of the DOE/AL Standards and Calibration Program. Specific areas covered include development projects, improvement projects, calibration and special measurements, surveys and audits, customer service, and significant events. Appendixes include certifications and reports;; a discussion about commercial calibration laboratories; PSL memoranda (PSLM); test numbers from the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS); and DOE/PSL memoranda on the Standards and Calibration Program with emphasis on traceability of PSL calibrations.

22463 (SAND–94-1196C) **The development of laser ignited deflagration-to-detonation transition (DDT) detonators and pyrotechnic actuators.** Merson, J.A.; Salas, F.J. Sandia National Labs., Albuquerque, NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–5: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011427. Source: OSTI; NTIS; GPO Dep.

The use of laser ignited explosive components has been recognized as a safety enhancement over existing electrical explosive devices (EEDs). Sandia has been pursuing the development of optical ordnance for many years with recent emphasis on developing optical deflagration-to-detonation (DDT) detonators and pyrotechnic actuators. These low energy optical ordnance devices can be ignited with either a semiconductor diode laser, laser diode arrays or a solid state rod laser. By using a semiconductor laser diode, the safety improvement can be made without sacrificing performance since the input energy required for the laser diode and the explosive output are similar to existing electrical systems. The use of higher powered laser diode arrays or rod lasers may have advantages in fast DDT applications or lossy optical environments such as long fiber applications and applications with numerous optical connectors. Recent results from our continued study of optical ignition of explosive and pyrotechnic materials are presented. These areas of investigation can be separated into three different margin categories: (1) the margin relative to intended inputs (i.e. powder performance as a function of laser input variation), (2) the margin relative to anticipated environments (i.e. powder performance as a function of thermal environment variation), and (3) the margin relative to unintended environments (i.e. responses to abnormal environments or safety).

22464 (UCRL-ID–115752) **CHEETAH: A fast thermochemical code for detonation.** Fried, L.E. Lawrence Livermore National Lab., CA (United States). Nov 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012586. Source: OSTI; NTIS; GPO Dep.

For more than 20 years, TIGER has been the benchmark thermochemical code in the energetic materials community. TIGER has been widely used because it gives good detonation parameters in a very short period of time. Despite its success, TIGER is beginning to show its age. The program's chemical equilibrium solver frequently crashes, especially when dealing with many chemical species. It often fails to find the C-J point. Finally, there are many inconveniences for the user stemming from the programs roots in pre-modern FORTRAN. These inconveniences often lead to mistakes in preparing input files and thus erroneous results. We are producing a modern version of TIGER, which combines the best features of the old program with new capabilities, better computational algorithms, and improved packaging. The new code, which will evolve out of TIGER in the next few years, will be called "CHEETAH." Many of the capabilities that will be put into CHEETAH are inspired by the thermochemical code CHEQ. The new capabilities of CHEETAH are: calculate trace levels of chemical compounds for environmental analysis; kinetics capability: CHEETAH will predict chemical compositions as a function of time given individual chemical reaction rates. Initial application: carbon condensation; CHEETAH will incorporate partial reactions; CHEETAH will be based on computer-optimized JCZ3 and BKW parameters. These parameters will be fit to over 20 years of data collected at LLNL. We will run CHEETAH thousands of times to determine the best possible parameter sets; CHEETAH will fit C-J data to JWL's,and also predict full-wall and half-wall cylinder velocities.

22465 (UCRL-JC–116445) **Calculations of NTS residual stress measurements and some implications for models and material properties.** Rambo, J. (Lawrence Livermore National Lab., CA (United States)); Rimer, N. Lawrence Livermore National Lab., CA (United States). Mar 1994. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9309103–7: 7. symposium on containment of underground

nuclear explosions, Kent, WA (United States), 13-17 Sep 1993). Order Number DE94013229. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Residual stress data were obtained from several events (Queso and Orkney in NTS Area 10, Hunters Trophy in Area 12). For Orkney, calculated and measured peak-stress attenuations were consistent, as were times of residual stress setup and rebound. Comparison of both stress components for Queso showed the failure surface up to about the time of residual stress rebound. Residual stress data in Area 10 material is in qualitative agreement with calculations, while data to date for tunnel events in Area 12 tuff are inconclusive. Stress gauges on Hunters Trophy generally showed a final state of tension. This study discusses the possible influence of material properties differences between the geologic areas.

4503 Nuclear Explosion Detection

Refer also to citation(s) 21923, 22752

22466 (LA-UR–94-1538) **User manual for the NTS ground motion data base retrieval program: ntsgm.** App, F.N. (Los Alamos National Lab., NM (United States). Earth and Environmental Sciences Div.); Tunnell, T.W. Los Alamos National Lab., NM (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012886. Source: OSTI; NTIS; GPO Dep.

The NTS (Nevada Test Site) Ground Motion Data Base is composed of strong motion data recorded during the normal execution of the US underground test program. It contains surface, subsurface, and structure motion data as digitized waveforms. Currently the data base contains information from 148 underground explosions. This represents about 4,200 measurements and nearly 12,000 individual digitized waveforms. Most of the data was acquired by Los Alamos National Laboratory (LANL) in connection with LANL sponsored underground tests. Some was acquired by Los Alamos on tests conducted by the Defense Nuclear Agency (DNA) and Lawrence Livermore National Laboratory (LLNL), and there are some measurements that were acquired by the other test sponsors on their events and provided for inclusion in this data base. Data acquisition, creation of the data base, and development of the data base retrieval program (ntsgm) are the result of work in support of the Los Alamos Field Test Office and the Office of Nonproliferation and Arms Control.

22467 (SAND–94-0293C) **The Non-Proliferation Experiment recorded at the Pinedale: Seismic research facility.** Carr, D.B. Sandia National Labs., Albuquerque, NM (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405158–1: Department of Energy symposium on the non-proliferation experiment results and implications for test ban treaties, Washington, DC (United States), 19-21 May 1994). Order Number DE94012917. Source: OSTI; NTIS; INIS; GPO Dep.

The Non-Proliferation Experiment was recorded by five different seismic stations operated by Sandia National Laboratories at the Pinedale Seismic Research Facility, approximately 7.60 from the Nevada Test Site. Two stations are different versions of the Deployable Seismic Verification System developed by the Department of Energy to provide seismic data to verify compliance with a Comprehensive Test Ban Treaty. Vault and borehole versions of the Designated Seismic Stations also recorded the event. The final station is test instrumentation located at depths of 10, 40 and 1200 feet. Although the event is seen clearly at all the stations, there are variations in the raw data due to the different bandwidths and depths of deployment. One Deployable Seismic Verification System has been operating at Pinedale for over three years and in that time recorded 14 nuclear explosions and 4 earthquakes from the Nevada Test Site, along with numerous other western U.S. earthquakes. Several discriminants based on the work by Taylor et al. (1989) have been applied to this data. First the discriminants were tested by comparing the explosions only to the 4 earthquakes located on the Test Site. Only one discriminant, $\log(L_g/P_g)$, did not show clear separation between the earthquakes and nuclear explosions. When other western U.S. events are included, only the m_b vs. M_s discriminant separated the events. In all cases where discrimination was possible, the Non-Proliferation Experiment was indistinguishable from a nuclear explosion.

4505 Strategic Defense Initiative

22468 (LA-SUB–94-81) **The BEAR program NRL plasma physics instrumentation measurements.** Walker, D.N. (Naval Research Lab., Washington, DC (United States)); Baumback, M.M.; Haas, D.G.; Rodriguez, P.; Siefring, C.L.; Doggett, R.A. Los Alamos National Lab., NM (United States); Naval Research Lab., Washington, DC (United States). 15 Nov 1989. 101p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AI32-88AL44716 ; W-7405-ENG-36. Order Number DE94012077. Source: OSTI; NTIS; GPO Dep.

The BEAR program was a joint effort to launch, and demonstrate the feasibility of operating, a 1 MeV 10 ma Neutral Particle Beam (NPB) accelerator from a space platform. The accelerator design and manufacture were the responsibility of Los Alamos National Lab (LANL); diagnostics associated with accelerator operation and beam-plasma effects were also to be undertaken by LANL and NRL. Payload Integration and Telemetry was provided by the Air Force Geophysical Lab (AFGL) and Northeastern University (NEU). Beam effects on the local plasma in addition to accelerator produced vehicle effects (e.g., charging) were the responsibility of NRL as outlined herein. The BEAR rocket was launched successfully during the early morning hours of July 13 from White Sands Missile Range, White Sands, N.M. The NRL contribution to this effort included three instrument packages designed to diagnose beam-plasma and vehicle-plasma interactions. The instruments included: (1) Langmuir probe (LP) design consisting of 4 separate sensors; (2) High voltage (HIV) Langmuir Probe designed to monitor vehicle charging through current polarity changes; and (3) Plasma Wave Receive (PWR) designed to characterize the plasma wave emissions covering a broad frequency range from near DC to 50 MHz.

4506 Chemical and Biological

Refer also to citation(s) 21918, 22545

54 ENVIRONMENTAL SCIENCES

Refer also to citation(s) 20884, 20940, 20942, 20945, 20982, 20987, 20997, 20998, 21001, 21012, 21017, 21021, 21029, 21030, 21032, 21383, 22053, 22054, 22055, 22056

22469 (DOE/EM–0158P) **Sampling quality assurance guidance in support of EM environmental sampling and analysis activities.** USDOE Assistant Secretary for Environmental Management, Washington, DC (United States). Analytical Services Div. May 1994. 37p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013041. Source: OSTI; NTIS; INIS; GPO Dep.

This document introduces quality assurance guidance pertaining to the design and implementation of sampling procedures and processes for collecting environmental data for DOE's Office of EM (Environmental Restoration and Waste Management).

22470 (INIS-mf–14214) **Environmental report of the Government of Lower Saxony 1992.** Niedersaechsisches Umweltministerium, Hannover (Germany). 1992. 219p. (In German). Order Number DE94773693. Source: OSTI; NTIS (US Sales Only); INIS.

The report examines environmental conditions, describes actions of the government of Lower Saxony and gives prospects for the development of the environmental situation. For the description of the environmental situation and development in Lower Saxony available data is used. The following chapters are contained: (A) introduction, (B) basic conditions of environmental policy in Lower Saxony, (C) environmental protection in different fields, (C1) natural preservation and landscape preservation, (C2) forest, (C3) soil, (C4) water, (C5) air, (C6) waste, (C7) noise, (C8) radioactivity and nuclear energy, (C9) food and commodity goods, (C10) chemicals and (C11) climate. A list of abbreviations, a list of addresses and

of important reports and programs of environmental policy is given in the appendix. (BBR). 1 separate map.

22471 (NEI-DK–1531) **National Environmental Research Institute R and D projects 1994.** Christensen, H. (ed.). Danmarks Miljoeundersoegelser, Roskilde (Denmark). Feb 1994. 120p. Order Number DE94771104. Source: OSTI; NTIS.

Published yearly.

The publication provides detailed information on the current research activities of the National Environmental Research Institute (NERI, Denmark). NERI operates under the Danish Ministry of the Environment with the task of carrying out both strategic and applied research and is responsible for the collection and overall management and coordination of data on nature and the environment. NERI aims at increased national and international cooperation in environmental research. The institute is also committed to providing Danish environmental authorities with extensive guidance and professional support. The scope of research is very broad, covering science, technology, and also the social sciences, but NERI's research concentrates on selected areas. Current subjects concern systems analysis related to environmental policy, microbiology, ecotoxicology, environmental and analytical chemistry, atmospheric research, environmental transport, the human impact on uncultivated areas, woodlands, streams and catchment areas and the processing and publication of environmental data. Project descriptions include the title of the project, names of project coordinator and other researchers involved and of collaborating institutions, external sponsoring agencies and foundations. The aims, structure and management of the NERI are described in detail. (AB)

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 20704, 20782, 20862, 20954, 20999, 21051, 21077, 21118, 21292, 21295, 21304, 21305, 21316, 21376, 21771, 22149, 22150, 22417, 22554, 22610, 22678, 22720, 22721, 22722, 22724, 22731, 23315

22472 (ANL/DIS/CP–82338) **Comparison of salient features of alternative CO_2 recovery processes.** Molburg, J.C.; Thimmapuram, P.; Doctor, R.D. Argonne National Lab., IL (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–14: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012651. Source: OSTI; NTIS; GPO Dep.

In the case of direct coal combustion, the recovery of carbon dioxide (CO_2) is complicated by dilution of the flue gas with nitrogen (N_2) from the combustion air, as well as with excess air, which invariably accompanies coal combustion. For a representative boiler using bituminous coal, the mole fraction of CO_2 in the flue gas is in the range of 10–15%. For coal gasification, no excess air is provided. In fact, the air supplied is inadequate for complete combustion. The mole fraction of carbon monoxide (CO) plus CO_2 in the fuel gas from the Kellogg-Rust-Westinghouse (KRW) gasifier, which is the gasifier for which these CO_2 recovery processes are designed, is about 22% for an air-blown gasifier and 59.1% for an oxygen-blown gasifier. The CO can be converted to CO_2 via the water-gas shift reaction. Because of the higher CO_2 partial pressure, recovery of the CO_2 from this shifted synthesis gas requires a less costly recovery system than that which would be required for recovery following direct coal combustion in air. This analysis is intended to provide a first-order estimate of the effects of CO_2 recovery on the cost and performance of a gasifier and to compare these effects for common commercial CO_2 recovery processes.

22473 (ANL/EAD/TM–13) **Air pathway analysis for cleanup at the chemical plant area of the Weldon Spring site.** Chang, Y.S. Argonne National Lab., IL (United States). Jan 1994. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94011140. Source: OSTI; NTIS; INIS; GPO Dep.

The Weldon Spring site is a mixed waste site located in St. Charles County, Missouri. Cleanup of the site is in the planning and design stage, and various engineering activities were considered for remedial action, including excavating soils, dredging sludge, treating various contaminated media in temporary facilities, transporting and staging supplies and contaminated material, and placing waste in an engineered disposal cell. Both contaminated and uncontaminated emissions from these activities were evaluated to assess air quality impacts and potential health effects for workers and the general public during the cleanup period. A site-specific air quality modeling approach was developed to address several complex issues, such as a variety of emission sources, an array of source/receptor configurations, and complicated sequencing/scheduling. This approach can be readily adapted to reflect changes in the expected activities as engineering plans are finalized.

22474 (ANL/ER/CP–81934) **Evaluation of parameterizations for pollutant transport and dispersion in an urban street canyon using a three-dimensional dynamic flow model.** Lee, I.Y. (Argonne National Lab., IL (United States)); Shannon, J.D.; Park, H.M. Argonne National Lab., IL (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–17: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012641. Source: OSTI; NTIS; GPO Dep.

Results produced from a 3-D, time-dependent flow model show that dispersion characteristics can be simulated and interpreted in terms of flow conditions and structural configurations. Our previously parameterized 2-D formulations for time constants are modified to include the effect of the orientation of the mean wind relative to the canyon. The parameterizations can be applied to urban air pollution models directly, because the independent parameters are readily available from mesoscale calculations. More numerical studies are planned to characterize turbulent flow in street canyons. The current version of the model will be coupled with an improved module to solve transport equations for turbulence kinetic energy and turbulence dissipation rate. A three-dimensional, time-dependent flow model has been applied to examine the processes by which pollutants emitted at street level are transported and diffused from street canyons, and to determine the exchange rates of pollutants between street canyons and the air above the canyon.

22475 (ANL/ER/CP–82908) **Modeling atmospheric concentrations and deposition of Hg.** Shannon, J.D. Argonne National Lab., IL (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940371–1: Methylmercury and human health, Upton, NY (United States), 22-23 Mar 1994). Order Number DE94012633. Source: OSTI; NTIS; GPO Dep.

The deleterious effects on ecosystems of mercury pollution are well established and fish advisories are in effect for many lakes in North America. Because methylation and other transformation processes in ecosystems can alter the original speciation of deposited Hg, a decrease in atmospheric loading of Hg in all forms is highly desirable. The contribution to Hg deposition by emissions from current anthropogenic activities relative to the deposition contribution by emissions from natural processes must be estimated to establish what fraction of atmospheric loading to watersheds and ecosystems is at least potentially amenable to control actions. Additional modeling questions concern source-receptor relationships (SRR) for major point sources and for emissions aggregated over geopolitical regions or emission sectors, because of the usefulness of SRR in comparing effectiveness of alternate control strategies. Modeling of atmospheric Hg is less advanced than that of some other widespread air pollution problems such as acid deposition. Nonetheless, several promising studies have been made for northern Europe and North America. For this study of Hg deposition in eastern North America we extend modeling techniques used extensively and successfully during the last 15 years for concentrations and deposition of SO_x and NO_x over regional scales, with parameterization rates adjusted to suitable values for Hg transformation and removal.

22476 (ANL/ES/CP–80868) **The potential for control of carbon dioxide emissions from integrated gasification/combined-cycle systems.** Livengood, C.D.; Doctor, R.D.; Molburg, J.C.; Thimmapuram, P.; Berry, G.F. Argonne National Lab.,

IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–16: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012646. Source: OSTI; NTIS; GPO Dep.

Initiatives to limit carbon dioxide (CO_2) emissions have drawn considerable interest to integrated gasification/combined-cycle (IGCC) power generation, a process that reduces CO_2 production through efficient fuel used is amenable to CO_2 capture. This paper presents a comparison of energy systems that encompass fuel supply, an IGCC system, CO_2 recovery using commercial technologies, CO_2 transport by pipeline, and land-based sequestering in geological reservoirs. The intent is to evaluate the energy-efficiency impacts of controlling CO_2 in such systems and to provide the CO_2 budget, or an to equivalent CO_2" budget, associated with each of the individual energy-cycle steps. The value used for the "equivalent CO_2" budget is 1 kg/kWh CO_2. The base case for the comparison is a 457-MW IGCC system that uses an air-blown Kellogg-Rust-Westinghouse (KRW) agglomerating fluidized-bed gasifier, Illinois No. 6 bituminous coal, and in-bed sulfur removal. Mining, preparation, and transportation of the coal and limestone result in a net system electric power production of 454 MW with a 0.835 kg/kwh CO_2 release rate. For comparison, the gasifier output is taken through a water-gas shift to convert CO to CO_2 and then processed in a glycol-based absorber unit to recover CO_2 Prior to the combustion turbine. A 500-km pipeline then transports the CO_2 for geological sequestering. The net electric power production for the system with CO_2 recovery is 381 MW with a 0.156 kg/kwh CO_2 release rate.

22477 (CBPF-NF–041/92) **Geometric effects affecting determination of radon family equilibrium factor in air samples.** Gil, L.R.; Marques, A.; Rivera, A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 20p. (In Portuguese). (CONF-9212117–: Symposium on Physics Experimental Techniques, Sao Paulo (Brazil), 10-11 Dec 1992). Order Number DE94625942. Source: OSTI; NTIS (US Sales Only); INIS.

Geometrical elements affecting the radon family equilibrium factor are examined in measuring with atmospheric samples. The general arguments are applied equally to any alpha-particles detector. However the examples worked out in this paper are restricted to the case of track solid detectors, with particular emphasis on the Cr-39. The equilibrium factor is calculated to squared and rectangular detector plates, with different dimensions and submitted to different temperatures in case the radioactive equilibrium rupture agent be common to every family members, such as the ventilation. No calibration procedures are necessary to this method. (L.C.J.A.).

22478 (CONF-8803294–1) **Long-range forces and the collisions of free-molecular and transition regime aerosols.** Marlow, W.H. Texas A and M Univ., College Station, TX (United States). [1988]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER60550. (KFK–4606). From Coagulation workshop; Karlsruhe (Germany); 16-18 Mar 1988. Order Number DE94011992. Source: OSTI; NTIS; GPO Dep.

An aerosol here is understood to be a two-component system comprised of gaseous and condensed phases with the characteristic that the condensed phase is not an equilibrium subsystem. In contrast to the usual definitions based upon geometrical or mechanical variables, this quasi-thermodynamic formulation is framed to emphasize the dynamical behavior of aerosols by allowing for coagulation and other aerosol evolutionary processes as natural consequences of the interactions and state variables appropriate to the system. As will become clear later, it also provides a point of departure for distinguishing aerosol particles from unstable gas-phase cluster systems. The question of accommodation in particle collisions must be addressed as a prelude to the discussion of the role of long-range forces. Microscopic reversibility is frequently assumed for molecular collisions with either molecules or solid surfaces. In the case of aerosol collisions, the implication of this assumption is that collisions are elastic, which is contrary to the evidence from coagulation experiments and the conventional operational assumption of sticking upon collision. Gay and Berne have performed computer simulations of the collision of two clusters consisting of a total of 135 molecules interacting via Lennard-Jones potentials. That work showed that complete accommodation, accompanied by overall heating of the unified cluster, occurred. Since heating represents an irreversible degradation of the kinetic energy of the collision, the hamiltonian of the two-cluster system should be considered as dissipative and therefore microscopic reversibility does not apply.

22479 (CONF-940115–32) **Modeling of trace constituent transport with the University of Wisconsin global isentropic-sigma model.** Zapotocny, T.H.; Johnson, D.R.; Reames, F.M. Wisconsin Univ., Madison, WI (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61439. From 74. American Meteorological Society annual meeting; Nashville, TN (United States); 23-28 Jan 1994. Order Number DE94012729. Source: OSTI; NTIS; GPO Dep.

The main goal of this report is to demonstrate the ability of the University of Wisconsin (UW) hybrid isentropic-sigma (θ-σ) model for global NWP, especially the global distribution of precipitation and simulating the long-range transport of an inert trace constituent. Results from this prototype climate model are compared against the results of a nominally identical global σ model in order to establish the relative advantages and disadvantages of each coordinate system for simulating long-range transport processes. The current work is an extension of works by Johnson et al. and Zapotocny et al. The first study used analytically specified initial conditions for θ-σ and σ coordinate channel models, the second study incorporated observed data into regional versions of both models, while the third study documented the first global results with the UW θ-σ model. Section 2 of this report describes additions to the UW θ-σ model since the Zapotocny et al. study, Section 3 evaluates a five day precipitation forecast produced by the UW θ-σ model and presents a comparison of each model's ability to prognostically simulate and conserve an inert trace constituent. A summary is presented in Section 4.

22480 (CONF-940650–7) **Replacement of chlorofluorocarbons (CFCs) at the DOE gaseous diffusion plants: An assessment of global impacts.** Socolof, M.L.; Saylor, R.E.; McCold, L.N. Oak Ridge National Lab., TN (United States). [1994]. 15p. Sponsored by USDOE Federal Energy Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual conference and exposition of the National Association of Environmental Professionals: global strategies for environmental issues; New Orleans, LA (United States); 12-15 Jun 1994. Order Number DE94013616. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) formerly operated two gaseous diffusion plants (GDPs) for enriching uranium and maintained a third shutdown GDP. These plants maintain a large inventory of dichlorotetrafluorethane (CFC-114), a cholorofluorocarbon (CFC), as a coolant. The paper evaluates the global impacts of four alternatives to modify GDP coolant system operations for a three-year period beginning in 1996. Interim modification of GDP coolant system operations has the potential to reduce stratospheric ozone depletion from GDP coolant releases while a permanent solution is studied.

22481 (DLR-FB–93-47) **A statistical-dynamical method for the regionalization of global climate simulations.** Frey-Buness, A. Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Wessling (Germany). Inst. fuer Physik der Atmosphaere; Muenchen Univ. (Germany). Fakultaet fuer Physik. 1993. 151p. (In German). Order Number DE94773758. Source: OSTI; NTIS (US Sales Only); INIS.

A statistical-dynamical procedure for the regionalization of the results of global climate simulations is presented. This procedure is based on a statistical link between global and regional model simulations. The results of multi-annual global climate simulations are used to define large-scale weather classes. To determine the typical regional climate induced by an complex orography and small-scale surface characteristics, model simulations with a three-dimensional mesoscale model for each class are performed. The regional climate is obtained by weighting the results of these simulations by the frequency of the large-scale weather classes. The

procedure is applied to the Alpine region. The results for the present-day climate reproduce observed climatic patterns. A global simulation of a warmer climate induced by enhanced CO_2 concentration is also used as input to the statistical-dynamical procedure. (orig.). 69 figs., 2 tabs., 111 refs.

22482 (DOE/CE/23810–38A) **Sealed tube comparisons of the compatibility of desiccants with refrigerants and lubricants: Quarterly technical progress report, January 1994–March 1994.** Field, J.E. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States); Spauschus Associates, Inc., Stockbridge, GA (United States). Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE94012371. Source: OSTI; NTIS; GPO Dep.

Continuing environmental concerns mandate replacement of CFC's with alternate refrigeration fluids. At this time relatively little testing has been reported in the literature for compatibility of desiccants in these new working fluids. Using bench scale test methods generally accepted throughout the industry today, this work will provide data necessary to assess the compatibility or virtually all of the currently used desiccant types - both bead and molded core, with thirteen refrigerant/lubricant combinations. The desiccants are tested by exposure to refrigerant and lubricant in sealed, glass tubes in accordance with ASHRAE/ANSI Standard 97-1989. After aging, the liquid phase is evaluated for acid anion formation, change in color, and presence of halide ions, the gas phase is analyzed for refrigerant decomposition by gas chromatography, and the desiccants are evaluated for changes in crush strength and for retention of acids and halide ions. Metal catalysts, also present in the sealed tubes, are visually examined for corrosion, copper plating, and appearance changes.

22483 (DOE/EIA–0573) **Emissions of greenhouse gases in the United States, 1985–1990.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 10 Nov 1993. 99p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008247. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

The Earth's capacity to support life depends on the moderating influences of gases that envelop the planet and warm its surface and protect it from harmful radiation. These gases are referred to as "greenhouse gases." Their warming capacity, called "the greenhouse effect," is essential to maintaining a climate hospitable to all plant, animal, and human life. In recent years, however, there has been increasing concern that human activity may be affecting the intricate balance between the Earth's absorption of heat from the sun and its capacity to reradiate excess heat back into space. Emissions of greenhouse gases from human activities may be an important mechanism that affects global climate. Thus, research is intensifying to improve our understanding of the role human activities might play in influencing atmospheric concentrations of greenhouse gases. On the basis of scientific findings of the past few decades, the US Government and the international community at large are now taking steps toward stabilizing greenhouse gas emissions. This report contributes to that process. Mandated by Congress this report provides estimates of US emissions of the principal greenhouse gases–carbon dioxide, methane, nitrous oxide, chlorofluorcarbons, carbon monoxide, nitrogen oxides, and nonmethane volatile organic compounds. Estimates are for the period 1985 to 1990. Preliminary estimates for 1991 have also been included, whenever data were available.

22484 (DOE/ER/61020–1) **The effect of cloud microphysics on climate sensitivity: Progress report, July 15, 1990–July 14, 1992.** Stamnes, K. Alaska Univ., Fairbanks, AK (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER61020. Order Number DE94009855. Source: OSTI; NTIS; GPO Dep.

Clouds play an important role in the climate system through radiative energy redistribution. The cloud radiative properties change if the cloud droplet size spectrum changes. This research shows that the climate is very sensitive to cloud water path and equivalent radius. To explore this issue, an accurate parameterization of cloud radiative properties for the purpose of climate modeling has been developed. A one-dimensional radiative convective model with a comprehensive radiative transfer scheme using the new parameterization of cloud radiative properties has also been developed to investigate the climate sensitivity to changes in cloud microphysics. By looking at clouds with different size distributions, we find that for clouds with the same cloud water amount and equivalent radius, the cloud radiative properties are essentially the same. Thus cloud radiative properties depend primarily on equivalent radius and are independent of the details of the size distribution. Our parameterization allows these two parameters to change independently. A sensitivity study has been performed, to consider cloud droplet size. First, we looked at cloud radiative forcing. The results show that the cloud radiative forcing is indeed very sensitive to the changes in cloud equivalent radius. Secondly, we have looked at the response of equilibrium temperature to changes in cloud equivalent radius. This sensitivity study suggests that in climate models, an interactive cloud parameterization is needed, in which cloud water amount and equivalent radius are predicted independently.

22485 (DOE/ER/61390–1) **Climate evolution with a coupled two dimensional atmosphere/ocean model: Final report, [March 1, 1992–August 31, 1993].** Hoffert, M.I.; Kheshgi, H. New York Univ., NY (United States). Dept. of Earth System Science. Feb 1994. 20p. Sponsored by USDOE, Washington, DC (United States);National Inst. for Global Environmental Change, Davis, CA (United States). DOE Contract FG02-92ER61390. (CONF-9303225–2: CHAMMP science meeting; NIGEC meeting, Monterey, CA (United States); New Orleans, LA (United States), 15-17 Mar 1993; 14-16 apr 1993; CONF-9304241–1). Order Number DE94008262. Source: OSTI; NTIS; GPO Dep.

To test the impact of a density-dependent eddy diffusivity law on global warming predictions, transient calculations with a standard upwelling-diffusion ocean/climate model were conducted. This report discusses that research. In addition, this report also presents the findings from research conducted on internal wave-breaking turbulence in an upwelling-diffusion ocean.

22486 (DOE/FTR–94005808) **Meetings between the United States and China concerning the greenhouse effect and climate change: Foreign trip report, December 31, 1993–January 6, 1994.** Riches, M.R. USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94005808. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Statement of Work on the four Tasks of the Joint USDOE-PRC/Chinese Academy of Sciences (CAS) Research Program on Greenhouse Gases Was revised and signed by both parties. The productivity of the research program and benefits to both Countries are recognized at high levels in the Chinese State Science and Technology Commission.

22487 (DOE/MC/26366–3758) **A calcium oxide sorbent process for bulk separation of carbon dioxide: Quarterly progress report No. 18, October 1993–December 1993.** Harrison, D.P. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Chemical Engineering. Jan 1994. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26366. Order Number DE94013215. Source: OSTI; NTIS; GPO Dep.

This research project is investigating the technical feasibility of a high-temperature, high-pressure (HTHP) process for the bulk separation of CO_2 from coal-derived gas. Phase I research, in which an electrobalance reactor was used to establish the technical feasibility of the regenerable sorbent process, was completed in March 1992 and results have been fully described in earlier quarterly reports. In Phase I, the calcination and carbonation characteristics of three calcium sorbents were studied as a function of calcination and carbonation temperature and pressure, mol fraction CO_2 in the carbonation gas, and carbonation background gas composition. Desirable reaction conditions required for high reactivity and good sorbent durability were determined. Multicycle tests consisting of as many as ten complete calcination and carbonation cycles were completed. Indirect evidence which suggested that the water-gas shift reaction occurred simultaneously with CO_2 removal was found. Occurrence of the simultaneous reactions created the possibility of a direct one-step process for the manufacture of hydrogen from coal-gas while at the same time separating a concentrated

stream of CO_2. The concentrated CO_2 stream could be quite significant if, in the future, environmental regulations restrict atmospheric CO_2, emissions.

22488 (DOE/PO–0011) **The Climate Change Action Plan: Technical supplement.** USDOE Assistant Secretary for Policy, Planning and Program Evaluation, Washington, DC (United States). Mar 1994. 148p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009191. Source: OSTI; NTIS; GPO Dep.

This Technical Annex documents the assumptions and parameters used in developing the supporting analysis for the Climate Change Action Plan (the Plan) issued by President Clinton on October 19, 1993. The Annex is intended to meet the needs of independent energy and environmental analysts who wish to better understand the Plan, its analytical underpinnings, and the events that need to transpire for the emissions reductions called for in the Plan to be realized. The Plan documented in this Annex reflects the outcome of a wide-ranging effort by Government agencies and interested members of the public to develop and implement actions that can reduce net greenhouse gas emissions in the year 2000 to their aggregate 1990 level. Based on agency and public input, the Climate Change Mitigation Group, chaired by the White House Office on Environmental Policy, developed the Plan's content. Many of the actions called for in the Plan are now underway, while others are in advanced planning pending congressional action on the fiscal year 1995 budget. The analysis supporting the Plan represents the results of an interagency effort. The US Department of Energy (DOE) was responsible for the integrated analysis of energy-related options, based on the analysis of individual energy-related options by DOE, the US Environmental Protection Agency (EPA), and the US Department of Transportation (DOT). EPA led in providing analysis for actions related to methane, hydrofluorocarbons, and perfluorocarbons. The US Department of Agriculture (USDA) led the analysis of carbon sequestration actions and cooperated with EPA in the analysis of actions to reduce nitrous oxide emissions.

22489 (ENEA-RT-AMB–92-25) **Greenhouse gas emissions considered responsible for climate change: Environmental indicators.** Vialetto, G. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Venanzi, M.; Gaudioso, D. ENEA, Bologna (Italy). Centro Ricerche Energia 'E. Clementel' - Area Energetica. Sep 1993. 23p. (In Italian). (RT/AMB–92-25). Order Number DE94775326. Source: OSTI; NTIS (US Sales Only); INIS.

This paper concerns the more significant environmental indicators related to the emissions of radiatively and chemically/photochemically active trace gases. Reference is made to the preliminary work of the Intergovernmental Panel on Climate Change (IPCC) and to the proposals made in the framework of the international negotiation on climate change. Aiming to contribute to the definition of a national strategy for the reduction of greenhouse gases emissions, this paper proposes a possible application of the indicators. The calculation of the indicators is based on the emission estimate performed by ENEA (Italian National Agency for Energy, New Technologies and the Environment) for the Report on the State of the Environment edited by the Italian Ministry of the Environment. Finally, the paper suggests an application of such indicators for the international negotiation, in the framework of the Italian proposal for the Convention on climate change.

22490 (ENEA-RT-AMB–93-01) **Air quality determination by non-automatic sampling of total suspended particulates and trace elements: Sampling, analysis and data validation techniques.** Castellani, C.M. (ENEA, Bologna (Italy). Area Energia Ambiente e Salute); Sassi, S.; Trevissoi, E.; Vicini, G. ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Oct 1993. 66p. (In Italian). (RT/AMB–93-01). Order Number DE94775262. Source: OSTI; NTIS (US Sales Only).

Air quality is related to complex environmental phenomena exhibiting large temporal and spatial variations. This work presents items concerning the reliability of the analytical methods used for quantitative analysis of trace pollutant (Pb, Cr, V, Ni Cd) concentrations in TSP at USL (Local Sanitary Unit) Bologna Nord PMP Laboratories in Italy. The purpose of the paper is to discuss the sampling method and selection of the equipment used, the calibration procedures and the data processing in order to assess the variability present in each step. The last section of the work determines the overall variability of concentration data, and reviews the difficulties still present in measuring air pollutants.

22491 (ENEA-RT-AMB–93-02) **Non-specific aerosol instrumentation: Applicability to urban air pollution monitoring and analysis.** De Zaiacomo, T. (ENEA, Bologna (Italy). Area Energia Ambiente e Salute); Formignani, M. ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Oct 1993. 44p. (In Italian). (RT/AMB–93-02). Order Number DE94775324. Source: OSTI; NTIS (US Sales Only).

After a brief mention of the instruments and methods used in the field of air pollution monitoring, the aerosol instrumentation of the ENEA (Italian Agency for Energy, New Technologies and the Environment) AMB-BIO-FITS Division that could be applied to the specific problem of the urban air pollution is listed and briefly described. Some analytical methods used to assess both qualitatively and quantitatively particulate matter collected on suitable supports are then summarized. Scanning Electron Microscopy (SEM) coupled with EDAX Microanalysis in evaluating morphologically and as-element-content aero-dispersed material collected on the various stages of a commercial type cascade impactor is given special attention. Experimental results of comparisons among real-time instruments, used to investigate the applicability of 'non-specific' aerosol instrumentation in the field of urban pollution, are then reported. Some proposals are put forward suggesting the use of some of these instruments in environmental monitoring to obtain real-time data and to better estimate the fraction of atmospheric particulate which is likely more noxious for the human respiratory system.

22492 (ES/ER/TM–66) **Oak Ridge Environmental Information System (OREIS) functional system design document.** Birchfield, T.E. (Martin Marietta Energy Systems, Inc., Piketon, OH (United States). Computing and Telecommunications Services); Brown, M.O.; Coleman, P.R. Oak Ridge National Lab., TN (United States). Mar 1994. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012143. Source: OSTI; NTIS; GPO Dep.

The OREIS Functional System Design document provides a detailed functional description of the Oak Ridge Environmental Information System (OREIS). It expands the system requirements defined in the OREIS Phase 1-System Definition Document (ES/ER/TM-34). Documentation of OREIS development is based on the Automated Data Processing System Development Methodology, a Martin Marietta Energy Systems, Inc., procedure written to assist in developing scientific and technical computer systems. This document focuses on the development of the functional design of the user interface, which includes the integration of commercial applications software. The data model and data dictionary are summarized briefly; however, the Data Management Plan for OREIS (ES/ER/TM-39), a companion document to the Functional System Design document, provides the complete data dictionary and detailed descriptions of the requirements for the data base structure. The OREIS system will provide the following functions, which are executed from a Menu Manager: (1) preferences, (2) view manager, (3) macro manager, (4) data analysis (assisted analysis and unassisted analysis), and (5) spatial analysis/map generation (assisted ARC/INFO and unassisted ARC/INFO). Additional functionality includes interprocess communications, which handle background operations of OREIS.

22493 (GKSS–93/E/57) **Exchange of momentum between atmosphere and ocean in coastal areas.** Rudolph, E. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). Inst. fuer Physik; Hamburg Univ. (Germany). Fachbereich 15 - Geowissenschaften. 1993. 99p. (In German). Order Number DE94773802. Source: OSTI; NTIS (US Sales Only); INIS.

In order to describe the physical processes in the wadden sea environment a coupled system of models for fetch limited areas is developed. Three models, a meteorological mesoscale model (GESIMA resp MKW), a shallow water wave model (HYPAS) and a current and water level model (NFMOD) are coupled iteratively. The influence of the periodic change of the water level due to tides on the local wind field is investigated as well as the interaction between waves and local wind field. Two different parameterizations

are used to describe the exchange of momentum between atmosphere and ocean. The coupled system of models is applied to the Lister Tidebecken in order to simulate wind, waves and water levels. A better agreement of model results and measurements of the significant wave height in coastal areas is achieved by taking into account the local wind field. (orig.). 54 figs., 1 tab.

22494 (HW–30618) **A new constant monitor for ruthenium and iodine in stack gases: Status report.** Eisenacher, P.L.; Nielsen, J.M. Hanford Works, Richland, WA (United States). 22 Jan 1954. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94009779. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Present methods for monitoring Ru^{103}, Ru^{106}, and I^{131} in stack gases involve sampling by filtration and scrubbing and analysis by chemical separation and counting or by gamma spectrometry. Filtered samples, which are ordinarily collected over a complete day, are analyzed for total ruthenium and iodine by gamma spectrometry and for the individual isotopes by chemical separation and counting. The present scrubber monitors the sampler gas for total activity. As an aid to Radiological Sciences evaluation of stack gas hazards and to operations control of radioactive gas emission, Methods and Instrument Development collaborated on the planning of a continuous monitoring system. This memorandum has the purpose of outlining the plan, reviewing progress since conception in October, 1953, and reporting work still to be done.

22495 (INIS-mf–14214, pp. 179-194) **Radioactivity and nuclear energy.** Niedersaechsisches Umweltministerium, Hannover (Germany). 1992. 219p. (In German). In *Environmental report of the Government of Lower Saxony 1992.* Order Number DE94773693. Source: OSTI; NTIS (US Sales Only); INIS.

In this chapter the position of Lower Saxony about the abandonment of nuclear power and the opposed opinions of the Federal and the State Government are described. Furthermore, operation, maintenance and occurrences in nuclear power plants are reported on. The problem of final storage of radioactive wastes is commented on and results of environmental radioactivity monitoring are given. (BBR)

22496 (INIS-mf–14215) **Balance of the air pollution reduction effect of new technologies in East Germany: Summary.** Kampet, T.; Broege, M.; Jappe, H.; Jones, E.; Koerner, T.; Lindner, H. Internationales Centrum fuer Energie- und Umwelttechnologie Leipzig GmbH (ICEU) (Germany). 1992. 31p. (In German). Order Number DE94774153. Source: OSTI; NTIS (US Sales Only); INIS.

Between 1989 and 2010, the energy supply in the new Federal States of Germany must undergo a reduction of environmental pollution. This is possible by changing of energy sources (e.g. reduction of using of brown coal), reduction of energy losses, reduction of emissions by improvements in the quality of fuel and by technical improvements for keeping air clean (e.g. dust filters). (VT)

22497 (INIS-mf–14218) **Physical modelling of the dispersion of heavy gases released in an accident for the assessment of hazardous areas in built-up terrain.** Berichte aus dem Zentrum fuer Meeres- und Klimaforschung. Reihe A: Meteorologie, v. 6. Marotzke, K. Hamburg Univ. (Germany). Zentrum fuer Meeres- und Klimaforschung; Hamburg Univ. (Germany). Fachbereich 15 - Geowissenschaften. 1993. 163p. (In German). Order Number DE94774212. Source: OSTI; NTIS (US Sales Only); INIS.

The report on experimental results which were obtained above all within the heavy gas dispersion phase of the clouds. This phase extends up to a distance from the source distance in which the initial heavy gas concentration has decreased to about 1% by volume of the source concentration. The lower ignition limit of all gases of interest for industrial applications is above this threshold; the ignition distances of combustible gases can therefore be determined directly in the physical model. The concentration field in the complex near field of the cloud is modelled physically. The results obtained in the wind tunnel serve as input data for a numeric model; the concentrations and the dose values at points in the far field can be calculated with the model. The main section contains a detailed dimensional analysis for the two fundamentally possible emission types, i.e. spontaneous and continuous emissions. An experimental program was developed on this basis. With the program, the heavy gas dispersion under the influence of 25 different obstacle configurations was investigated. The results were represented in diagrams. With the aid of the diagrams, the lower ignition distances can be determined for combustible gases; for toxic gases, the initial conditions for the numeric far field model. (orig./KW)

22498 (INIS-mf–14224) **Integrated project 'Supply and disposal of pure chemicals and gases'. Vol. 11: Component investigations, particle measurements on gas supply components. Final report.** Dorner, J.; Herz, R.; Klumpp, B.; Schmidt, H.P.; Trompler, H.; Mueller, B.; Ernst, C. Fraunhofer-Institut fuer Produktionstechnik und Automatisierung (IPA), Stuttgart (Germany). 12 Dec 1990. 77p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT NT 2772; Project Number FhG IPA 910155. Order Number DE94774223. Source: OSTI; NTIS (US Sales Only); INIS.

A gas filter test rig was designed and built up, in which the contamintion behaviour of point-of-use filters can be examined. After checking and improving individual components, particle measurements were carried out on three point-of-use filters to determine the particle emission with static and dynamic loading of the test filter. The filters had a poly-dispersed NaCl aerosol applied to them for this purpose. The particle release in the delivered state was also determined on a filter taken from the original packing. The results of the particle application test show that an appreciable particle flow occurs for pressure surges. However, with steady state flow, no particle flow was found. The measurements were carried out according to a fixed and even course of the experiment. (orig.)

22499 (INIS-mf–14226) **Volatile monoterpenes in a stand of Picea abies (L.) Karst: Emission sites, emission mechanisms and fate in the atmosphere. Final report.** Schuermann, W.; Eichstaedter, G.; Steinbrecher, R.; Schoenwitz, R.; Gabriel, R.; Karbach, I.; Zufall, N.; Ziegler, H. Technsiche Univ. Muenchen (Germany). Inst. fuer Botanik und Mikrobiologie. 1992. 194p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 07EU722. Order Number DE94774258. Source: OSTI; NTIS (US Sales Only); INIS.

Natural emissions of terpene and their fate in the atmosphere were investigated in a forest stand of the Bayerischer Wald mountains. Terpenes are volatile hydrocarbons whose relevance for air chemistry has increased considerably in the past few years. The investigation compared different sources of terpene in order to determine their strength as a function of meteorological, air-chemical and biological parameters. (orig./BBR)

22500 (INIS-mf–14229) **Industry and power plants 1987/88: Pollutant emission records.** Informationsreihe zur Luftreinhaltung in Berlin, v. 10. Garn, D.; Kuban, W.; Reichenbaecher, W.; Werner, G. Senator fuer Stadtentwicklung und Umweltschutz, Berlin (Germany). Aug 1990. 39p. (In German). Order Number DE94774259. Source: OSTI; NTIS (US Sales Only); INIS.

For the urban area of (West) Berlin the monitored emissions of air pollutants which are emitted in the atmosphere by industry and power plants (plants subject to approval and supervision) are published. For 1987 and 1988 the total emissions (CO, SO_2, NO_2, halogenated hydrocarbons and dusts), dusts from combustion processes, emissions of heavy metals, hydrocarbons and solvents, organic oxygene compounds and halogenated hydrocarbons are given. The development of emissions from industry is described and discussed with chosen pollutants for 1979, 1983, 1985, 1987 and 1988. (BBR)

22501 (INIS-mf–14232) **Principal oscillation patterns: Review paper.** Report - Max-Planck-Institut fuer Meteorologie, v. 113. Storch, H. von (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Buerger, G.; Schnur, R.; Storch, J.S. von. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Sep 1993. 48p. Order Number DE94774156. Source: OSTI; NTIS (US Sales Only); INIS.

The Principal Oscillation Pattern (POP) analysis is a technique which is used to simultaneously infer the characteristic patterns and time scales of a vector time series. The POPs may be seen as the normal modes of a linearized system whose system matrix is

estimated from data. The concept of POP analysis is reviewed. Examples are used to illustrate the potential of the POP technique. The best defined POPs of tropospheric day-to-day variability coincide with the most unstable modes derived from linearized theory. POPs can be derived even from a space-time subset of data. POPs are successful in identifying two independent modes with similar time scales in the same data set. The POP method can also produce forecasts which may potentially be used as a reference for other forecast models. The conventional POP analysis technique has been generalized in various ways. In the cyclostationary POP analysis, the estimated system matrix is allowed to vary deterministically with an externally forced cycle. In the complex POP analysis not only the state of the system but also its "momentum" is modeled. Associated correlation patterns are a useful tool to describe the appearance of a signal previously identified by a POP analysis in other parameters. (orig.)

22502 (INIS-mf–14233) **Climatology and variability in the ECHO coupled GCM.** Report - Max-Planck-Institut fuer Meteorologie, v. 114. Latif, M.; Stockdale, T.; Wolff, J.; Burgers, G.; Maier-Reimer, E.; Junge, M.M.; Arpe, K.; Bengtsson, L. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Sep 1993. 39p. Order Number DE94774155. Source: OSTI; NTIS (US Sales Only); INIS.

ECHO is a new global coupled ocean-atmosphere general circulation model (GCM), consisting of the Hamburg version of the European Centre atmospheric GCM (ECHAM) and the Hamburg Primitive Equation ocean GCM (HOPE). We performed a twenty year integration with ECHO. Climate drift is significant, but typical in the open oceans. Near the boundaries, however, SST errors are considerably larger. The coupled model simulates an irregular ENSO cycle in the tropical Pacific, with spatial patterns similar to those observed. The mechanism behind the model ENSO is related to the subsurface memory of the system, but stochastic forcing by the atmosphere seems to be also important. The variability, however, is somewhat weaker relative to observations. ECHO also simulates significant interannual variability in midlatitudes. Consistent with observations, variability over the North Pacific can be partly attributed to remote forcing from the tropics. In contract, the interannual variability over the North Atlantic appears to be generated locally. Indications for decadal-scale variability are also found over the North Atlantic. (orig.)

22503 (INIS-mf–14234) **Reconstruction of the El Nino attractor with neural networks.** Report - Max-Planck-Institut fuer Meteorologie, v. 112. Grieger, B.; Latif, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Sep 1993. 28p. Order Number DE94774229. Source: OSTI; NTIS (US Sales Only); INIS.

Based on a combined data set of sea surface temperature, zonal surface wind stress and upper ocean heat content the dynamics of the El Nino phenomenon is investigated. In a reduced phase space spanned by the first four EOFs two different stochastic models are estimated from the data. A nonlinear model represented by a simulated neural network is compared with a linear model obtained with the Principal Oscillation Pattern (POP) analysis. While the linear model is limited to damped oscillations onto a fix point attractor, the nonlinear model recovers a limit cycle attractor. This indicates that the real system is located above the bifurcation point in parameter space supporting self-sustained oscillations. The results are discussed with respect to consistency with current theory. (orig.)

22504 (INIS-mf–14235) **Water tracers in the general circulation model ECHAM.** Report - Max-Planck-Institut fuer Meteorologie, v. 110. Hoffmann, G.; Heimann, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Aug 1993. 15p. Order Number DE94774218. Source: OSTI; NTIS (US Sales Only); INIS.

We have installed a water tracer model into the ECHAM General Circulation Model (GCM) parameterizing all fractionation processes of the stable water isotopes ($^1H_2\ ^{18}O$ and $^1H^2H\ ^{16}O$). A five year simulation was performed under present day conditions. We focus on the applicability of such a water tracer model to obtain information about the quality of the hydrological cycle of the GCM. The analysis of the simulated $^1H_2\ ^{18}O$ composition of the precipitation indicates too weak fractionated precipitation over the Antarctic and Greenland ice sheets and too strong fractionated precipitation over large areas of the tropical and subtropical land masses. We can show that these deficiencies are connected with problems of model quantities such as the precipitation and the resolution of the orography. The linear relationship between temperature and the $\delta^{18}O$ value, i.e. the Dansgaard slope, is reproduced quite well in the model. The slope is slightly too flat and the strong correlation between temperature and $\delta^{18}O$ vanishes at very low temperatures compared to the observations. (orig.)

22505 (INIS-mf–14236) **BLUME - the Berlin air pollution monitoring network: Results obtained in winter 1987/88.** Informationsreihe zur Luftreinhaltung in Berlin, v. 4. Lutz, M. Senator fuer Stadtentwicklung und Umweltschutz, Berlin (Germany). Referat Presse- und Oeffentlichkeitsarbeit. Sep 1988. 81p. (In German). Order Number DE94774162. Source: OSTI; NTIS (US Sales Only); INIS.

This report compiles the BLUME air pollution chracteristics obtained in winter 1987/88. Figures and tables summarize and compare the measuring results obtained for sulfur dioxide, airborne particles, carbon monoxide, nitrogen oxides and ozone. Air pollution in winter 1987/88 was not as critical as in the previous years. The 1987/88 mean sulfur dioxide concentrations were found to be the lowest values determined since BLUME measurements started in 1975, and the mean values obtained for airborne particles and for most of the remaining pollutants were lower than in the previous year. The causes of these relatively low pollutant concentrations are discussed. (orig./BBR)

22506 (INIS-mf–14237) **Climate variability in a coupled GCM. Pt. 2: The Indian Ocean and Monsoon.** Report - Max-Planck-Institut fuer Meteorologie, v. 104. Latif, M.; Sterl, A.; Assenbaum, M.; Junge, M.M.; Maier-Reimer, E. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Apr 1993. 31p. Order Number DE94774152. Source: OSTI; NTIS (US Sales Only); INIS.

The seasonal cycle and the interannual variability of the tropical Indian Ocean circulation are investigated and the Indian Summer Monsoon is simulated by a coupled ocean-atmosphere general circulation model in a 26 year integration. Although the model exhibits significant climate drift, it simulates realistically the seasonal changes in the tropical Indian Ocean and the onset and evolution of the Indian Summer Monsoon. The amplitudes of the seasonal changes, however, are somewhat underestimated. The coupled GCM also simulates considerable interannual variability in the tropical Indian Ocean circulation which is partly related to the El Nino/Southern Oscillation (ENSO) phenomenon and the associated changes in the Walker Circulation. Changes in the surface wind stress appear to be crucial in forcing interannual variations in the Indian Ocean SST. As in the Pacific Ocean, the net surface heat flux acts as a negative feedback on the SST anomalies. The interannual variability in Monsoon rainfall is simulated by the coupled GCM only about half as strongly as observed. (orig.)

22507 (INIS-mf–14238) **Tropospheric ozone lidar intercomparison experiment, TROLIX '91, field phase report.** Report - Max-Planck-Institut fuer Meteorologie, v. 102. Boesenberg, J. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Ancellet, G.; Apituley, A.; Bergwerff, H. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Apr 1993. 241p. Order Number DE94774151. Source: OSTI; NTIS (US Sales Only); INIS.

The Tropospheric Ozone Lidar Intercomparison Experiment TROLIX '91 has been initiated as part of the TESLAS subproject of the cooperative programme EUROTRAC. It has been performed in June 1991 at the Rijksinstitut voor Volksgezondheid en Milieuhygiene (RIVM) in Bilthoven, The Netherlands. The experiment was based on the simultaneous operation of different types of differential absorption lidars (DIAL), a special version of a Differential Optical Absorption Spectroscopy Instrument (DOAS), helicopter borne in situ instruments, and many other supporting measurements. After a short introduction to the general methodology the instruments are described, the experimental operations are explained, and a selection of data are presented. Some examples are given for the results of the intercomparison, as far as they have been available at the present stage of evaluation. The main purpose of this report, however, is to provide an overview over the material collected during the experiment, on order to facilitate further detailed studies in cooperation between the different groups which have participated. (orig.)

22508 (INIS-mf–14239) **Annual report 1990/91 for the Hamburg air monitoring network.** Hamburger Umweltberichte, v. 37/92. Luft, Wasser, Boden. Goemer, D.; Hache, W.; Matzen, D.; Reich, T. Umweltbehoerde, Hamburg (Germany). Oct 1992. 95p. (In German). Order Number DE94774264. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to measured results form the stationary air monitoring network from 1990 (detailed report) and 1991 (brief version), the annual report 1990/91 presents results form special measuring programs of the dynmao car area and from measurements made on the street dating from 1990/91. After a detailed presentation of the meteorological frame conditions in 1990, distinguishing by a relatively good air exchange, a detailed discussion of the air load during this period and a brief survey about the air quality in 1991 follows. (orig.)

22509 (INIS-mf–14240) **Discharge data from 50 selected rivers for GCM validation.** Report - Max-Planck-Institut fuer Meteorologie, v. 100. Duemenil, L. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Isele, K.; Liebscher, H.J.; Schroeder, U.; Schumacher, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Mar 1993. 65p. Order Number DE94774251. Source: OSTI; NTIS (US Sales Only); INIS.

This Technical Report refers to a joint project between GRDC Koblenz and MPI Hamburg. The Global Runoff Data Centre operates under the auspieces of WMO at the Federal Institute of Hydrology (Bundesanstalt fuer Gewaesserkunde) in Koblenz. River discharge data of the 50 largest rivers provide an independent data source for the validation of the hydrological cycle in general circulation models. This type of data is particularly valuable, because in some cases the available time series are exceptionally long. The data are presented as time series of annual average discharge (averaged over the period for which data is available, see below for caveats) and as annual cycles of monthly mean discharge averaged over the length of the time series available. (orig./KW)

22510 (INIS-mf–14241) **Atmospheric emissions of agricultural ammonia and methane: Sources and prevention.** Schriften der Landwirtschaftskammer Rheinland, v. 72. Reinken, G. (comp.). Landwirtschaftskammer Rheinland, Bonn (Germany). Sep 1991. 58p. (In German). Order Number DE94774269. Source: OSTI; NTIS (US Sales Only); INIS.

The brochure discusses the contribution of agriculture to air pollution with gaseous emissions, the emission sources, and the options for preventing or reducing emissions. (orig.)

22511 (INIS-mf–14242) **Analysis of the origin and composition of airborne particulate pollution: Final report.** Israel, G.W.; Erdmann, A.; Shen Jian; Frenzel, W.; Ulrich, E. Technische Univ. Berlin (Germany). Inst. fuer Technischen Umweltschutz. Jan 1992. 289p. (In German). Sponsored by Umweltbundesamt, Berlin (Germany);Senator fuer Stadtentwicklung und Umweltschutz, Berlin (Germany). Project Number UFOPLAN 10402597. Order Number DE94774267. Source: OSTI; NTIS (US Sales Only); INIS.

Methods were developed for determination of airborne particulate pollution sources and origins from airborne particulate measurements, analyses of particulate constituents and routine meteorological measurements. The results obtained provide the basis for quantification of the long- and short-time impacts of these pollution sources on immission. The methods were tested in a densely populated urban area (West Berlin) and in a rural district (Waldhof, District of Uelzen) by collecting airborne particulates (fine and coarse particulates) at six measuring points by use of dichotomous collectors and high-volume collectors. The measurements were taken twice a day from November 1989 to November 1990. Analyses were made of the compounds and of the constituents Al, Fe, Si, Ca, Mg, K, Na, As, Cd, Cu, Ni, Sb, Se, V, Zn, Cl^-, NO^-_3, SO^{2-}_4, NH^+_4, organic carbons (OC) and inorganic elementary (EC) carbons. (orig.). 104 refs., 66 tabs., 79 figs.

22512 (INIS-mf–14246) **Turbulent exchange processes of the planetary boundary layer - TUAREG: Final report.** Beier, N.; Weber, M. Muenchen Univ. (Germany). Meteorologisches Inst. Nov 1992. 182p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 0743139. Order Number DE94774261. Source: OSTI; NTIS (US Sales Only); INIS.

A mobile groundstation with associated sovftware has been developed to measure fluxes of properties and constituents, and the vertical distribution of chemically reactive trace gases. The significance and accuracy of the derived fluxes have been investigated. Within the validity of the meteorological assumptions used, the error is less than 10%. The turbulent vertical transport has been investigated over homogeneous areas in mixed heterogeneous terrain during four field experiments. The following results were obtained: characteristics of the structure of the turbulence - diurnal variations of the fluxes of momentum and energy - the vertical distribution of NO, NO_2 and O_3 - diurnal variations of their flux and deposition velocity - balance of ozone and exchange processes in the convective PBL. Correlation and profile measurements at a fixed point in mixed heterogeneous terrain are representative of the surface type, if the upwind dimension of the homogeneous areas is at least 500 m. If this is not the case, anisotropic and organized turbulence develops. Then the formally calculated fluxes arise, in part, due to random numbers and cannot be attributed to a local site. A definitive conclusion would require measurements of the three dimensional structure of turbulence. There are no counter-gradient fluxes in the nondivergent PBL. They arise from the use of inadequate integration intervals in correlation and profile calculations. In contrast, they do occur in regions of divergence. Since the similarity theory is not valid in this case, fluxes can be neither measured nor calculated. Airborne measurements were carried out by the "Institut fuer Physik der Atmosphaere", DLR. The following results are attached: the mean structure of the PBL - the turbulent fluxes of meteorological variables - the horizontal variability of the fluxes near the ground - the turbulent flux of ozone and the ozone balance. Comparisons with model calculations show good agreement.

22513 (INIS-mf–14248) **Investigation of the dispersion of airborne pollutants in the Upper Rhine and Lake Constance region: Report of results.** Schriftenreihe 'Region-Aktuell', v. 14. Fiedler, F.; Adrian, G.; Kohler, M. Regionalverband Hochrhein-Bodensee, Waldshut-Tiengen (Germany). 1991. 133p. (In German). Order Number DE94774225. Source: OSTI; NTIS (US Sales Only); INIS.

Annex p. 57-124 presents parts of the diploma thesis of M. Kohler, Karlsruhe Univ., 1990.

The aim of the project is to calculate the regional flow and propagation conditions using the expensive three-dimensional meteorological model, the "Karlsruher Atmosphaerisches Mesoskaliges Modell" (KAMM) in order to derive the immission and the deposition of the conducting substance of pollutant matter, i.e., sulphur dioxide. In this report, calculations of the flowing field are described for the region Upper Rhine - Lake of Constance". In the last part, the concentration fields for SO_2 are calculated for the region for typical large-area atmospheric conditions with disclosure of sources. An appraising discussion of the results concludes this work. (orig.)

22514 (INIS-mf–14250) **Vertical profiles, fluxes and deposition rates of O_3, NO_x and SO_2 in a spruce stand of the Bayerischer Wald mountains.** Enders, G. Muenchen Univ. (Germany). Lehrstuhl fuer Bioklimatologie und Angewandte Meteorologie. Dec 1992. 87p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany);Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Foerderkennzeichen BMFT 0339113B. Order Number DE94774248. Source: OSTI; NTIS (US Sales Only); INIS.

Even the investigations underlying this report, conducted by the Professorship for Bioclimatology and Applied Meteorology at University of Munich, were originally conceived as pure deposition studies (i.e., gas phase, etc.) for researching the damage to forests. But, however, other disciplines were also suggested for additional experiments at the same location through the infrastructure, experimental configuration and preliminary results of this project. This consequently led to the development of a continuous and intensive cooperation of several foreign and domestic groups, in terms of the partial field BIATEX ('Biosphere/Atmosphere Exchange of Pollutants') of the European environmental research program EUROTRAC ('Transport and Transformation of Trace Constituent

over Europe'). These groups were assigned the task of also recording emission processes and reactions with deposited materials and, thus, describe physical and chemical interactions between the atmosphere and the special ecosystem 'forest'. The chief and, at the same time, sole objective of the investigations was to study, exclusively, deposition processes and, in this respect, only those relating to the gas phase, although the influence of trace materials occurs in all three states of aggregation in an ecosystem. (orig./KW)

22515 (INIS-mf–14252) **Numerical experiments on the atmospheric response to cold Equatorial Pacific conditions ('La Nina') during northern summer.** Report - Max-Planck-Institut fuer Meteorologie, v. 106. Storch, H. von (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Schriever, D.; Arpe, K.; Branstator, G.W.; Legnani, R.; Ulbrich, U. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). May 1993. 23p. Order Number DE94774224. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of cold conditions in the central and eastern Equatorial Pacific during Northern Summer is examined in a series of numerical experiments with the low resolution (T21) atmospheric general circulation model ECHAM2. Anomalous sea surface temperatures (SST) as observed in June 1988 were prescribed and the effect on the global circulation is examined. In the model atmosphere, the anomalous cold water in the Equatorial Pacific excites a strong and stable response over the tropical Central and East Pacific. From here stationary Rossby waves radiate into both hemispheres. The Northern Hemisphere wave train is weak and affects only the Northeast Pacific area; the Southern Hemisphere wave train arches from the Central Pacific over the southern tip of South America to the South Atlantic. This response is not only present in the basic anomaly experiment with the T21 GCM but also in experiments with SST anomalies confined to the tropics and with an envelope-formulation of the SST anomalies, in experiments with a linear model, and in high resolution (T42) model experiments. The model output is also compared to the actually observed atmospheric state in June 1988. (orig./KW)

22516 (INIS-mf–14253) **Study of the emission of low molecular weight organic compounds of various plants: Final report.** Steinbrecher, R.; Stahl, K.; Slemr, J.; Hahn, J. Fraunhofer-Institut fuer Atmosphaerische Umweltforschung (IFU), Garmisch-Partenkirchen (Germany). 1992. 73p. (In German). Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Foerderkennzeichen BMFT 07EU720. Order Number DE94774252. Source: OSTI; NTIS (US Sales Only); INIS.

Biogenic hydrocarbons are known to act as important precursors in tropospheric photochemical ozone formation. Large uncertainties exist about the composition of the mix of volatile organic compounds, emitted by various plant species and the respective emission rates. The emission and deposition behavior of wheat plants, as far as C_2 to C_9 hydrocarbons (NMHC), formaldehyde, and acetaldehyde are concerned, was studied both in the field (BIATEX experimental site, Manndorf, Bavaria) and in the laboratory. Vertical flux rates of the different compounds ranged from -4 to +4 nmol C m^{-2} surface area s^{-1}. Aldehydeemission showed a seasonal trend with high rates in spring and lower towards the end of the vegetation period. Ambient temperature appears to control only the flux of ethane, ethene, propane and propene, whereas acetaldehyde emission by wheat plants as well as by Norway spruce is controlled by light. Over a spruce canopy (BIATEX experimental site Schachtenau, Bayerischer Wald, national park, FRG) the 12 most abundant NMHC exhibited no distinct diurnal cycle, and only small differences in mixing ratios were detected between two heights (31 and 51 m) revealing that the impact of the canopy on the abundances of the non-terpenoid NMHCs present in the air above the canopy was small. Aldehyde mixing ratios above a spruce canopy, however, may significantly be influenced either by direct emission of aldehydes from spruce or by production of aldehydes during photochemical degradation of precursors. (orig.). 87 refs., 4 tabs., 25 figs.

22517 (IVL-B–1138) **Effects of exhaust gases from cars on forest growth close to heavily trafficated roads.** Westling, O. (IVL Aneboda, Lammhult (Sweden)); Skaerby, L.; Lindgren, O.; Soederlund, A. Swedish Environmental Research Inst., Lammhult (Sweden). IVL-Aneboda. Mar 1994. 25p. (In Swedish). Order Number DE94771022. Source: OSTI; NTIS.

The aim of this study was to investigate the role of traffic emissions on forest tree growth in the close vicinity of two main roads with heavy traffic in southern Sweden. For comparison, reference plots close to the road growing next to clearings, were used. The background loads and levels of polutants are regionally high in this area. Radial growth of Scots pine and Norway spruce was studied in eleven plots. Growth was measured at different distances from the road and clearings. The growth pattern was compared along the distance gradients from the road and between the reference and road plots. At one of the study sites incorporating six plots, the road was opened in 1980. Two plots, one for each species, were used as reference plots. The results for Scots pine, using two plots, show that the radial growth increased when the road was built. However, in the wind direction from the road the growth was slower than the corresponding growth at the other side of the road and the reference site. This indicated that the car exhaust may have had a direct negative effect on the growth. With the Norway spruce trees, using two plots, the same tendency was seen but the reference trees were not as comparable in this case. The other study area, using five plots, was situated close to the road which was built in 1930. Here, the growth patterns did not indicate any specific effect that could be related to either direct effects on traffic emissions or effect of the high background load of pollutants. This study has not been able to show any clear-cut and significant effects on radial tree growth due to hydrocarbons or other potentially harmful compounds emitted from cars. The study does not exclude the possibility, however, that car exhausts may cause effects on trees other than increased or decreased growth. 13 refs, 15 figs, 2 tabs

22518 (IVL-B–1139) **Air pollution in central Sweden: Deposition and effects October 1992 - September 1993.** Hallgren Larsson, E.; Westling, O. Swedish Environmental Research Inst., Lammhult (Sweden). IVL-Aneboda. Apr 1994. 54p. (In Swedish). Order Number DE94771021. Source: OSTI; NTIS.

The purpose of the monitoring programme is to quantify sulphur and nitrogen deposition to forests, and to illustrate possible acidification of the soil. Deposition is investigated by precipitation studies in open field areas and by throughfall studies in forest stands. Soilwater chemistry is examined in the forest stands and used as indication of soil condition. This report concerns the hydrological year from October 1992 through September 1993 for 38 locations in six counties in central Sweden. Precipitation pH-values averaged 4.5 to 4.6. All areas showed higher deposition of sulphur in forest stands than the critial load, 2.5-3.0 kg per hectare and year. The highest amounts were found at cape Vaermlandsnaes in lake Vaenern, Gladoe outside Huddinge in the county of Stockholm, and the forest stand outside Norrkoeping in the county of Oestergoetland. Sulphur deposition at the rest of the locations amounted 3.4 to 8.9 kg per hectare. Wet deposition of nitrogen amounted between 2.6 and 8.5 kg per hectare. Most throughfall samples showed lower values. Results from the county of Stockholm showed higher values of nitrogen deposition than open field measurements at three out of eight locations. The critial load of nitrogen for this region is 4-5 kg per heactare and year. With the exception for the northwestern parts, only wet deposition showed higher values at most locations. With a few exceptions, nitrogen in soilwater showed low values depending on biosorption of nitrogen in the ecosystem. Low soilwater pH ($\approx$4.5) have mainly been found in the county of Oerebro. Together with small amounts of base cations and large amounts of aluminium this indicated that soil acidification was more advanced in this area, compared to the other areas. High pH-values, indicating satisfying buffering capacity, have mainly been found in soilwater from one forest stand in the norhern part of the county of Stockholm and three areas in the county of Soedermanland.

22519 (LA–12699-Vol.4) **Mexico City air quality research initiative: Volume IV. Characterization and measurement.** Mauzy, A. (ed.). Los Alamos National Lab., NM (United States). Apr 1994. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013201. Source: OSTI; NTIS; GPO Dep.

This volume describes the methods and the data gathered in an attempt to measure and characterize the meteorological factors

and the concentration of different pollutants in the Mexico City Metropolitan Area. The main objective of this document was to provide input for the simulation models and to obtain information that could be used to test and improve the models' performance. Four field campaigns were conducted, as well as routine monitoring, in order to obtain a database of atmospheric dynamics and air pollution characteristics. Sections include Airborne measurements, Remote sensing measurements, and Traditional (in situ) measurements.

22520 (LA-UR–94-1848) **Tests of a new cloud treatment in an atmospheric general circulation model.** Kristjansson, J.E. Los Alamos National Lab., NM (United States). 8 Dec 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305289–3: Center for Nonlinear Studies international conference on modeling the forces of nature, Los Alamos, NM (United States), 17-21 May 1993). Order Number DE94013138. Source: OSTI; NTIS; GPO Dep.

In this study we present a new cloud treatment in an atmospheric climate model. The water (or ice) content of clouds is a introduced as a prognostic variable, subject to both advective and diffusive transport. In the first phase of the study, the cloud water does not affect the radiative properties of clouds. We then find differences in precipitation and cloud fields, but little effect on the overall climate. In the second phase the cloud water determines the reflectivity of the clouds. This causes large changes in the global circulation, largely due to enhanced reflection from high tropical cirrus clouds. As a third step, the cloud emissivity is also based on the cloud water content. This greatly enhances the outgoing terrestrial radiation and brings the model's radiative budget quite close to the observed.

22521 (NREL/TP–430-6084) **Bibliography of work on the photocatalytic removal of hazardous compounds from water and air.** Blake, D.M. National Renewable Energy Lab., Golden, CO (United States). May 1994. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE94006906. Source: OSTI; NTIS; GPO Dep.

This is a bibliography of information in the open literature on work that has been done to date on the photocatalytic oxidation of compounds, principally organic compounds. The goal of the listing is removing hazardous oompounds from water or air. It contains lists of substances and literature citations. The bibliography includes information obtained through the middle of 1993 and some selected references for the balance of that year.

22522 (ORNL/CDIAC–34/R4) **Catalog of data bases and reports.** Oak Ridge National Lab., TN (United States). Apr 1994. 186p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012230. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication No. 4244.

This document provides information about the many reports and other materials made available by the US Department of Energy (DOE) Global Change Research Program (GCRP). It is divided into nine sections plus author and title indexos. The reports in Section A provide information about the scope, activities, and direction of the GCRP, Sections B, C, D, and E contain information about research that has been sponsored by GCRP, including those produced by CDIAC.

22523 (ORNL/CDIAC–56) **Daily temperature and precipitation data for 223 USSR Stations.** Razuvaev, V.N. (Research Institute of Hydrometeorological Information, Obninsk (Russian Federation)); Apasova, E.G.; Martuganov, R.A.; Vose, R.S.; Steurer, P.M. Oak Ridge National Lab., TN (United States). Nov 1993. 118p. Sponsored by USDOE, Washington, DC (United States);National Oceanic and Atmospheric Administration, Washington, DC (United States). DOE Contract AC05-84OR21400. (NDP–040). Order Number DE94012496. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication No. 4194.

On- May 23, 1972, the United States and the USSR established a bilateral initiative known as the Agreement on Protection of the Environment. Given recent interest in possible greenhouse gas-induced climate change, Working Group VIII (Influence of Environmental Changes on Climate) has become particularly useful to the scientific communities of both nations. Among its many achievements, Working Group VIII has been instrumental in the exchange of climatological information between the principal climate data centers of each country [i.e., the National Climatic Data Center (NCDC) in Asheville, North Carolina, and the Research Institute of Hydrometeorological Information in Obninsk, Russia]. Considering the relative lack of climate records previously available for the USSR, data obtained via this bilateral exchange are particularly valuable to researchers outside the former Soviet Union. To expedite the dissemination of these data, NOAA's Climate and Global Change Program funded the Carbon Dioxide Information Analysis Center (CDIAC) and NCDC to distribute one of the more useful archives acquired through this exchange: a 223-station daily data set covering the period 1881-1989. This data set contains: (1) daily mean, minimum, and maximum temperature data; (2) daily precipitation data; (3) station inventory information (WMO No., name, coordinates, and elevation); (4) station history information (station relocation and rain gauge replacement dates); and (5) quality assurance information (i.e., flag codes that were assigned as a result of various data checks). The data set is available, free of charge, as a Numeric Data Package (NDP) from CDIAC. The NDP consists of 18 data files and a printed document which describes both the data files and the 223-station network in detail.

22524 (ORNL/FTR–4844) **Travel to Spain for the Global Change and Terrestrial Ecosystems (GCTE) Core Project and to the Netherlands to study the effects of sulfur deposition in Asia: Foreign trip report, November 13–24, 1993.** Gardner, R.H. Oak Ridge National Lab., TN (United States). 7 Dec 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004613. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in a four-day workshop in Toledo, Spain, to review and plan a research agenda for Global Change and Terrestrial Ecosystems (a core project of the International Geosphere-Biosphere Programme) on Global Change and Landscape Dynamics in Mediterranean Systems. The Focus 2 working group of Global Change and Terrestrial Ecosystems, which develops models for predicting the dynamics of composition and structure at the patch, landscape, and regional levels, organized the workshop. The workshop presented the relevant background on Mediterranean systems, discussed how research should be organized to achieve the goals of the Focus 2 working group, and recommended changes in the work plan to achieve these goals. The traveler was also invited to confer with J.P. Hettelingh of The National Institute of Public Health and Environmental Protection (RIVM) in The Netherlands on an international project studying the effects of sulfur deposition in Asia. The project is producing a methodology and assessment of the consequences of emission reduction strategies of sulfur dioxide emissions for Asia.

22525 (PNL-SA–22546) **Representing the influence of subgrid topography on hydrology.** Leung, L.R.; Ghan, S.J. Pacific Northwest Lab., Richland, WA (United States). Oct 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9310135–4: 32. Hanford symposium on health and the environment, Richland, WA (United States), 18-21 Oct 1993). Order Number DE94004595. Source: OSTI; NTIS; GPO Dep.

Estimates of the impact of global climate change on land surface hydrology require climate information on scales far smaller than those explicitly resolved by global climate models of today and the foreseeable future. To bridge the gap between what is required and what is resolved, we propose a subgrid-scale parameterization of the influence of topography on clouds, precipitation, and land surface hydrology. The parameterization represents subgrid variations in surface elevation in terms of discrete elevation classes. Separate cloud and surface processes are calculated for each elevation class. The simulated surface temperature, precipitation, snowpack, and soil moisture for each elevation class can then be distributed according to the spatial distribution of surface elevation within each grid cell. The scheme is being applied to the Pacific Northwest Laboratory's climate version of the Penn State/NCAR Mesoscale

Model. Validation is being addressed by driving the model with observed lateral boundary conditions for the Pacific Northwest and comparing with surface observations. Preliminary results from the simulation will be presented.

22526 (PNL-SA–23172) **Climate uncertainty and the regional economic impacts of global climate change.** Scott, M.J.; Liebetrau, A.M.; Lopresti, C.A. Pacific Northwest Lab., Richland, WA (United States). Oct 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-931085–1: Symposium on regional impacts of global climate change: assessing change and response at the scales that matter, Richland, WA (United States), 19-21 Oct 1993). Order Number DE94012242. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy funded pioneering research analyzing the effects of climate change and CO^2 fertilization at the regional level in the Missouri-Iowa-Nebraska-Kansas (MINK) region. That study used existing process models of the agricultural, water, energy, and forestry sectors and of the regional economy to conduct a wide-ranging, integrated analysis of the regional economic effects of climate change. Neither the full integration of the process models nor the full investigation of the uncertainties of climate and economic response to climate was accomplished because (1) the process models were time-consuming to run, and (2) the MINI(study used a single rich historical climate analog – the 1930s " Dustbowl" period – to depict climate change. More analysis was required to develop ranges of climate influences over more extreme climate conditions.

22527 (PNL-SA–23416) **On the development of boundary layer secondary circulations resulting from horizontally varying surface heat flux.** Shaw, W.J.; Doran, J.C. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940362–5: 21. American Meteorological Society conference on agricultural and forest meteorology, San Diego, CA (United States), 7-10 Mar 1994). Order Number DE94011234. Source: OSTI; NTIS; GPO Dep.

During the last decade there has been a surge in efforts to understand the processes at work in the inhomogeneous atmospheric boundary layer. Much of the interest in the problem has been driven by increasingly urgent needs to develop accurate assessments of man's Contribution to climate change. It has been argued that subgrid-scale secondary circulations in the boundary layer can cause significant errors in parameterized turbulent surface fluxes. Such circulations – variously termed "inland breezes", "lake breezes", "snow breezes", or "nonclassical mesoscale circulations" are becoming widely discussed and modeled. Because surface fluxes are part of the lower boundary condition for global climate models, it is important to understand when these circulations occur and what their effects are on overall turbulent transfer. What are not yet clear are the combinations of the ambient wind and the horizontal scale and intensity of surface flux variability under which we may expect boundary layer secondary circulations to occur. Several authors have modeled the development of these circulations for ad hoc situations of alternating surface characteristics, and SA have developed one parameterization relating the scale of surface heat flux variability and the ambient wind to the evolution of NCMCs. In this paper we present observations, collected in a region of inhomogeneous surface fluxes, that suggest the development of a "farm breeze", and we develop an alternative scaling argument to that of SA that better represents our measurement conditions.

22528 (PNWD–2252-HEDR) **User instructions for the CIDER Dose Code.** Eslinger, P.W.; Lessor, K.S.; Ouderkirk, S.J. Pacific Northwest Lab., Richland, WA (United States). May 1994. 150p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012494. Source: OSTI; NTIS; GPO Dep.

This document provides user instructions for the CIDER (Calculation of Individual Doses from Environmental Radionuclides) computer code. The CIDER code computes estimates of annual doses estimated for both reference individuals with a known residence and food consumption history. This document also provides user instructions for four utility codes used to build input data libraries for CIDER. These utility codes are ENVFAC (environmental factors), FOOFAC (food factors), LIFFAC (lifestyle factors), and ORGFAC (organ factors). Finally, this document provides user instructions for the EXPAND utility code. The EXPAND code processes a result file from CIDER and extracts a summary of the dose information for reporting or plotting purposes.

22529 (RFP–4858) **US Department of Energy radionuclide air emissions annual report (under Subpart H of 40 CFR Part 61) calendar year 1993.** EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90RF62349. Order Number DE94013014. Source: OSTI; NTIS; GPO Dep.

This report contains information collected by the Rocky Flats Plant concerning the emission of radionuclides into the air. Topics discussed include: Facility information, source description, air emissions data, dose assessments, point and non-point sources, and supplemental information on decontamination of concrete docks.

22530 (SAND–92-2245) **Large Scale Obscuration and Related Climate Effects Workshop: Proceedings.** Zak, B.D.; Russell, N.A.; Church, H.W.; Einfeld, W.; Yoon, D.; Behl, Y.K. (eds.). Sandia National Labs., Albuquerque, NM (United States); RDA Logicon, Albuquerque, NM (United States). May 1994. 62p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9201174–: Large scale obscuration and related climate effects workshop, Albuquerque, NM (United States), 29-31 Jan 1992). Order Number DE94012993. Source: OSTI; NTIS; GPO Dep.

A Workshop on Large Scale Obsurcation and Related Climate Effects was held 29–31 January, 1992, in Albuquerque, New Mexico. The objectives of the workshop were: to determine through the use of expert judgement the current state of understanding of regional and global obscuration and related climate effects associated with nuclear weapons detonations; to estimate how large the uncertainties are in the parameters associated with these phenomena (given specific scenarios); to evaluate the impact of these uncertainties on obscuration predictions; and to develop an approach for the prioritization of further work on newly-available data sets to reduce the uncertainties. The workshop consisted of formal presentations by the 35 participants, and subsequent topical working sessions on: the source term; aerosol optical properties; atmospheric processes; and electro-optical systems performance and climatic impacts. Summaries of the conclusions reached in the working sessions are presented in the body of the report. Copies of the transparencies shown as part of each formal presentation are contained in the appendices (microfiche).

22531 (SAND–94-0478C) **Real-time SAW measurements of NVR in cleanroom and in microenvironment.** Liang, A.Y.; McIntyre, D.C.; Lujan, R.D.; Thornberg, S.M.; Bender, S.F.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940510–6: 40. annual technical meeting and exposition of the Institute of Environmental Sciences (IES), Rosemont, IL (United States), 1-6 May 1994). Order Number DE94011937. Source: OSTI; NTIS; GPO Dep.

Using a real-time, Surface Acoustic Wave (SAW) sensing instrument supplied by Femtometrics, we have measured organic contamination, or nonvolatile residues (NVR), in both a cleanroom and a microenvironment. To demonstrate the "real-time" NVR detectability and sensitivity of the SAW instrument, controlled contamination experiments with photoresist material were also conducted. In addition, two cleaning methods for removing contamination from used sensors have been evaluated. One technique uses the on-board temperature varying capability of the SAW instrument, while the other technique utilizes a uv-ozone cleaner for the sensor cleaning. Preliminary results from SAW measurements in the cleanroom and in a microenvironment and tests to evaluate sensor cleaning techniques are presented in this report. A concluding summary with an assessment of the current SAW instrument and potential future applications for this technology is also presented.

22532 (SAND–94-1198C) **Processing solid propellants for recycling.** Whinnery, L.L.; Griffiths, S.K.; Handrock, J.L.; Lipkin, J.

Sandia National Labs., Livermore, CA (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405136–3: 1994 joint USA-Russia energetic material technology symposium, Livermore, CA (United States), 18-25 May 1994). Order Number DE94011433. Source: OSTI; NTIS; GPO Dep.

Rapid evolution in the structure of military forces worldwide is resulting in the retirement of numerous weapon systems. Many of these systems include rocket motors containing highly energetic propellants based on hazardous nitrocellulose/nitroglycerin (NC/NG) mixtures. Even as the surplus quantities of such material increases, however, current disposal methods – principally open burning and open detonation (OB/OD) – are coming under close scrutiny from environmental regulators. Environmentally conscious alternatives to disposal of propellant and explosives are thus receiving renewed interest. Recycle and reuse alternatives to OB/OD appear particularly attractive because some of the energetic materials in the inventories of surplus weapon systems represent potentially valuable resources to the commercial explosives and chemical industries. The ability to reclaim such resources is therefore likely to be a key requirement of any successful technology of the future in rocket motor demilitarization. This document consists of view graphs from the poster session.

22533 (SAND–94-1501C) **Preliminary DIAL model.** Gentry, S.; Taylor, J.; Stephenson, D. Sandia National Labs., Albuquerque, NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404162–7: 1994 caliope interim technical review, Livermore, CA (United States), 26-28 Apr 1994). Order Number DE94013243. Source: OSTI; NTIS; GPO Dep.

A unique end-to-end LIDAR sensor model has been developed supporting the concept development stage of the CALIOPE UV DIAL and UV laser-induced-fluorescence (LIF) efforts. The model focuses on preserving the temporal and spectral nature of signals as they pass through the atmosphere, are collected by the optics, detected by the sensor, and processed by the sensor electronics and algorithms. This is done by developing accurate component sub-models with realistic inputs and outputs, as well as internal noise sources and operating parameters. These sub-models are then configured using data-flow diagrams to operate together to reflect the performance of the entire DIAL system. This modeling philosophy allows the developer to have a realistic indication of the nature of signals throughout the system and to design components and processing in a realistic environment. Current component models include atmospheric absorption and scattering losses, plume absorption and scattering losses, background, telescope and optical filter models, PMT (photomultiplier tube) with realistic noise sources, amplifier operation and noise, A/D converter operation, noise and distortion, pulse averaging, and DIAL computation. Preliminary results of the model will be presented indicating the expected model operation depicting the October field test at the NTS spill test facility. Indications will be given concerning near-term upgrades to the model.

22534 (SAND–94-8595C) **Measurements and modeling of the effect of convective clouds on the upper tropospheric moisture budget.** Bisson, S.E. (Sandia National Labs., Livermore, CA (United States)); Goldsmith, J.E.M.; Del Genio, A.D. Sandia National Labs., Livermore, CA (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-940277–3: Atmospheric radiation measurement science team meeting, Charleston, SC (United States), 28 Feb - 3 mar 1994). Order Number DE94012239. Source: OSTI; NTIS; GPO Dep.

The goal of this study is to determine the upper tropospheric moisture budget associated with convective events, and in particular to extend process models to higher altitudes than have been achieved previously. Although upper tropospheric moisture concentrations are several orders of magnitude lower than those near the surface, upper tropospheric moisture exerts an important influence on climate. On a per-molecule basis, greenhouse absorption due to water vapor is about one hundred times more effective at high altitudes than at low altitudes. Several one-dimensional radiative convective models have been used to demonstrate the importance of upper tropospheric moisture on climate. These models show that for a given fractional increase in water vapor at a given altitude the response or change in surface temperature is qualitatively the same. At present, considerable controversy exists over the nature of the vertical redistribution of water vapor in a changing climate, and particularly the distribution of water vapor in the upper troposphere. Lacking suitable data, this controversy is also reflected in the cumulus parameterization schemes that are currently used in models. Understanding upper tropospheric moistening processes are therefore of prime importance in addressing the water vapor feedback question.

22535 (SAND–94-8640C) **UAVs in climate research: The ARM Unmanned Aerospace Vehicle Program.** Bolton, W.R. Sandia National Labs., Livermore, CA (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-9405146–1: AUVS '94: Association of Unmanned Vehicle Systems conference, Detroit, MI (United States), 25 May 1994). Order Number DE94011753. Source: OSTI; NTIS; GPO Dep.

In the last year, a Department of Energy/Strategic Environmental Research and Development Program project known as "ARM-UAV" has made important progress in developing and demonstrating the utility of unmanned aerospace vehicles as platforms for scientific measurements. Recent accomplishments include a series of flights using an atmospheric research payload carried by a General Atomics Gnat UAV at Edwards AFB, California, and over ground instruments located in north-central Oklahoma. The reminder of this discussion will provide background on the program and describe the recent flights.

22536 (UCRL-ID–116544) **Results from the LLNL Eulerian GRANTOUR model for the WCRP '93 workshop on the parameterization of sub-grid scale tracer.** Bergmann, D.; Dignon, J.; Penner, J.; Walton, J. Lawrence Livermore National Lab., CA (United States). Apr 1994. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012411. Source: OSTI; NTIS; GPO Dep.

GRANTOUR is a 3D chemical transport model (CTM) developed at LLNL which has been applied to a diverse set of problems in the troposphere. GRANTOUR uses fields supplied by a GCM and calculates the advection of inert or chemically reactive trace species in a Lagrangian scheme. The atmosphere is divided into "parcels" of equal mass and the center of mass of each of these parcels is accurately advected in a Lagrangian manner with little or no numerical diffusion. The advantage of this approach is the accuracy of the advection, while the disadvantages of this scheme are the difficulties in resolving the stratosphere and accurately inferring fluxes from the movements of the center of masses of the parcels. An Eulerian option has recently been implemented in GRANTOUR which uses a second order Van Leer scheme to transport inert or reactive trace species through a fixed three dimensional grid. Although this new model introduces a small amount of numerical diffusion which the Lagrangian approach did not have, it provides the potential to accurately resolve the stratosphere and to diagnose important quantities such as fluxes across the equator or the tropopause.

22537 (UCRL-ID–116552) **Transuranic radionuclides from resuspension in the environment, a bibliography.** Stoker, A.C. (and others); Shinn, J.H.; Noshkin, V.E. Lawrence Livermore National Lab., CA (United States). Apr 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012410. Source: OSTI; NTIS; GPO Dep.

The purpose of this project was to compile a bibliography of references containing environmental transuranic radionuclide data. Our intent was to identify those parameters affecting transuranic radionuclide transport that may be generic and those that may be dependent on chemical form and/or environmental conditions. An understanding of the unique characteristics and similarities between source terms and environmental conditions relative to transuranic radionuclide transport and cycling will provide the ability to assess and predict the long term impact on man and the environment. An additional goal of our literature review, was to extract the ranges of environmental transuranic radionuclide data from the

identified references for inclusion in a data base. Related to source term, these ranges of data can be used to calculate the dose to man from the radionuclides, and to perform uncertainty analyses on these dose assessments. On the basis of our reviews, we have arbitrarily outlined five general source terms. These are fallout, fuel cycle waste, accidents, disposal sites and resuspension. Resuspension of the transuranic radionuclides is an unique source term, in that the radionuclides can originate from any of the other source terms. If these transuranic radionuclides become resuspended into the air, they then become important as a source of inhaled radionuclides. This bibliography is a compilation of the references containing studies of plutonium and americium in the environment as a result of resuspension.

22538 (UCRL-JC–115082-Rev.1) **Impact of biomass burning on the atmosphere: Revision 1.** Dignon, J. Lawrence Livermore National Lab., CA (United States). Apr 1994. 17p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303250–1-Rev.1: North Atlantic Treaty Organization (NATO) advanced research workshop on ice core studies of global biogeochemical cycles, Annecy (France), 26-31 Mar 1993). Order Number DE94011741. Source: OSTI; NTIS; GPO Dep.

Fire has played an important part in biogeochemical cycling throughout much of the history of our plant. This report addresses the coupled evolution of our planet's atmospheric composition and biomass burning. Special attention is paid to the chemical and climatic impacts of biomass burning on the atmosphere throughout the last century, specifically looking at the cycles of carbon, nitrogen, and sulfur. Information from ice core measurements may be useful in understanding the history of fire and its historic affect on the composition of the atmosphere and climate.

22539 (UCRL-JC–116530) **Project report: Aircraft.** Wuebbles, D.J. (Lawrence Livermore National Lab., CA (United States)); Baughcum, S.; Metwally, M.; Seals, R. Lawrence Livermore National Lab., CA (United States). Apr 1994. 4p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9311208–1: 4. international workshop on global emissions inventories, Boulder, CO (United States), 30 Nov - 2 dec 1993). Order Number DE94011759. Source: OSTI; NTIS; GPO Dep.

Analyses of scenarios of past and possible future emissions are an important aspect of assessing the potential environmental effects from aircraft, including the proposed high speed civil transport (HSCT). The development of a detailed three-dimensional database that accurately represents the integration of all aircraft emissions along realistic flight paths for such scenarios requires complex computational modeling capabilities. Such a detailed data set is required for the scenarios evaluated in this interim assessment. Within the NASA High-Speed Research Program, the Emissions Scenarios Committee provides a forum for identifying the required scenarios and evaluating the resulting database being developed with the advanced emissions modeling capabilities at the Boeing Company and McDonnell Douglas Corporation.

22540 (WINCO–1207) **ICPP environmental monitoring report CY-1993: Environmental characterization.** Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). May 1994. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE94012996. Source: OSTI; NTIS; INIS; GPO Dep.

Summarized in this report are the data collected through Environmental Monitoring programs conducted at the Idaho Chemical Processing Plant (ICPP) by the Environmental Safety & Health (ES&H) Department. This report is published in response to DOE Order 5400.1. This report covers the period from December 21, 1992 through December 20, 1993. The ICPP is responsible for complying with all applicable Federal, State, Local and DOE Rules, Regulations and Orders. Radiological effluent and emissions are regulated by the DOE in accordance with the Derived Concentration Guides (DCGs) as presented in DOE Order 5400.5. The State of Idaho regulates all nonradiological waste resulting from the ICPP operations including all airborne, liquid, and solid waste. The ES&H Department updated the Quality Assurance (QA) Project Plan for Environmental Monitoring activities during the third quarter of 1992. QA activities have resulted in the ICPP's implementation of the Environmental Protection Agency (EPA) rules and guidelines pertaining to the collection, analyses, and reporting of environmentally related samples. Where no EPA methods for analyses existed for radionuclides, WINCO methods were used.

22541 (WSRC-MS–94-0176) **Environmental radiation monitoring technology: Capabilities and needs.** Hofstetter, K.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940524–2: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94011688. Source: OSTI; NTIS; INIS; GPO Dep.

Radiation monitoring in the Savannah River Site (SRS) environment is conducted by a combination of automated, remote sampling and/or analysis systems, and manual sampling operations. This program provides early detection of radionuclide releases, minimizes the consequences, and assesses the impact on the public. Instrumentation installed at the release points monitor the atmospheric and aqueous releases from SRS operations. Ground water and air monitoring stations are strategically located throughout the site for radionuclide migration studies. The environmental radiological monitoring program at SRS includes: fixed monitoring stations for atmospheric radionuclide concentrations, aqueous monitors for surface water measurements, mobile laboratory operations for real-time, in-field measurements, aerial scanning for wide area contamination surveillance, and hand-held instruments for radionuclide-specific measurements. Rigorous environmentnal sampling surveillance coupled with laboratory analyses provide confirmatory results for all in-field measurements. Gaps in the technologies and development projects at SRS to fill these deficiencies are discussed in the context of customer needs and regulatory requirements.

22542 (WSRC-MS–94-0234) **Measurement of actinides in environmental samples by Photo-Electron Rejecting Alpha Liquid Scintillation.** Cadieux, J.R. (Westinghouse Savannah River Co., Aiken, SC (United States)); Clark, S.; Fjeld, R.A.; Reboul, S.; Sowder, A. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940524–1: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94010815. Source: OSTI; NTIS; GPO Dep.

This work describes the adaptation of extractive scintillation with a Photo-Electron Rejecting Alpha Liquid Scintillation (PERALS) (ORDELA, Inc.) spectrometer to the analysis of actinides in environmental samples from the Savannah River Site (SRS). Environmental quality assurance standards and actual water samples were treated by one of two methods; either a two step direct extraction, or for more complex samples, pretreatment by an extraction chromatographic separation prior to measurement of the alpha activity by PERALS.

22543 (WSRC-MS–94-0244) **Long-range mesoscale modeling of pollutant transport for the European Tracer EXperiment (ETEX).** Fast, J.D.; Griggs, D.P.; Addis, R.P. Westinghouse Savannah River Co., Aiken, SC (United States). 15 Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940769–1: 6. conference on mesoscale processes, Portland, OR (United States), 18-22 Jul 1994). Order Number DE94010820. Source: OSTI; NTIS; GPO Dep.

The European Tracer EXperiment (ETEX). The ETEX program involves two tracer experiments each comprising from distinct elements: (a) long-range atmospheric tracer release, sampling, and analysis; (b) real-time model operation and evaluation; and (c) post-release model operation and evaluation. The experiments consist of the release of a non-buoyant tracer from a location in western Europe and sampling of the atmospheric concentration by a network of about 200 stations located in 17 countries. Twenty-three institutions from 19 countries are expected to participate in the real-time modeling program including the Savannah River

Technology Center (SRTC) of the US Department of Energy's Savannah River Site (SRS). Notification of the release will occur only after the initiation of the release. Participants will be required to provide 60-h concentration predictions as quickly a possible (within 6 h of being notified) and updated predictions every 12 h after the notification. In 1993 two "dry runs" for the real-time modeling component of the program were conducted; the actual tracer release experiment is scheduled for the fall of 1994. This paper describes the modeling approach employed by SRTC and presents some of the results of the second ETEX real-time dry run.

22544 (WSRC-TR–94-077) **Savannah River Site environmental data for 1993.** Arnett, M.W. (ed.). Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 289p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94011668. Source: OSTI; NTIS; INIS; GPO Dep.

The figures and tables in this report represent a capsule view of the routine environmental monitoring and surveillance programs at the Savannah River Site. An attempt has been made to include all available data from environmental research programs. The first section of the book is a collection of maps of radiological and nonradiological sampling locations. Also included are general radiological and nonradiological sampling and analysis schedules; a list of the media sampled, along with sample sizes and representative aliquots; a list of the lower limits of detection for radiological detection instruments; the minimum detectable concentrations for gamma analysis of water and air samples; and the minimum detectable concentrations for gamma analysis of soil, food, fish and wildlife, and vegetation samples. Following the first section are data tables containing radiological and nonradiological effluent monitoring results, radiological and nonradiological environmental surveillance results, dose estimates, quality assurance activities, and results of nonroutine occurrences and special surveys.

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Refer also to citation(s) 20769, 20844, 20849, 20861, 20868, 20869, 20883, 20888, 20902, 20905, 20932, 20934, 20936, 20937, 20939, 20941, 20953, 20972, 20981, 20999, 21002, 21010, 21016, 21026, 21034, 21038, 21050, 21053, 21057, 21059, 21061, 21064, 21066, 21070, 21074, 21075, 21076, 21077, 21083, 21090, 21091, 21094, 21100, 21101, 21102, 21104, 21107, 21118, 21133, 21378, 21686, 21696, 21701, 22049, 22073, 22417, 22424, 22472, 22491, 22513, 22523, 22527, 22528, 22540, 22543, 22617, 22627, 22630, 22637, 22665, 22720, 22721, 22725, 23314

22545 (ANL/CMT-ACL/CP–82554) **Development of self-absorption coefficients for the determination of gamma-emitting radionuclides in environmental and mixed waste samples.** Streets, W.E. Argonne National Lab., IL (United States). [1994]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940524–3: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94011491. Source: OSTI; NTIS; INIS; GPO Dep.

As the need for rapid and more accurate determinations of gamma-emitting radionuclides in environmental and mixed waste samples grows, there is continued interest in the development of theoretical tools to eliminate the need for some laboratory analyses and to enhance the quality of information from necessary analyses. In gamma spectrometry the use of theoretical self-absorption coefficients (SACs) can eliminate the need to determine the SAC empirically by counting a known source through each sample. This empirical approach requires extra counting time and introduces another source of counting error, which must be included in the calculation of results. The empirical determination of SACs is routinely used when the nuclides of interest are specified; theoretical determination of the SAC can enhance the information for the analysis of true unknowns, where there may be no prior knowledge about radionuclides present in a sample. Determination of an exact SAC does require knowledge about the total composition of a sample. In support of the Department of Energy's (DOE) Environmental Survey Program, the Analytical Chemistry Laboratory (ACL) at Argonne National Laboratory developed theoretical self-absorption models to estimate SACs for the determination of non-specified radionuclides in samples of unknown, widely-varying, compositions. Subsequently, another SAC model, in a different counting geometry and for specified nuclides, was developed for another application. These two models are now used routinely for the determination of gamma-emitting radionuclides in a wide variety of environmental and mixed waste samples.

22546 (ANL/EAD/TM–14) **Chemical Stockpile Disposal Program: Review and comment on the Phase 1 environmental report for the Pueblo Depot Activity, Pueblo, Colorado.** Olshansky, S.J.; Krummel, J.R.; Policastro, A.J.; McGinnis, L.D. Argonne National Lab., IL (United States). Mar 1994. 22p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94011173. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the Chemical Stockpile Disposal Program, an independent review is presented of the US Army Phase I environmental report for the disposal of chemical agents and munitions stored at the Pueblo Depot Activity (PUDA) in Pueblo, Colorado. The Phase I report addresses new and additional concerns not incorporated in the final programmatic environmental impact statement (FPEIS). These concerns are addressed by examining site-specific data for the PUDA. On the basis of our review of the Phase I report, we concluded that on-site meteorological data from December 1988 to June 1992 appear to be of insufficient quality to have been used instead of the off-site Pueblo airport data. No additional meteorological data have been collected since June 1992. The Phase I report briefly mentions problems with the air pollution control system. These problems will likely require the systems to be upgraded at the Johnston Atoll site and at each of the other depots in the continental United States. Without such improvements, the probability of accidents during start-up and shutdown would likely increase. The Army has a lessons-learned program to incorporate improvements into the design of future facilities. The Phase I report does not make any design change commitments. These issues need to be fully evaluated and resolved before any final conclusion concerning the adequacy of the decision in the FPEIS can be made with respect to the PUDA. With the exception of this issue, the inclusion of other more detailed site-specific data in the Phase I report does not change the decision reached in the FPEIS (which favored on-site disposal at the PUDA). We recommend that site-specific data on water, ecological, socioeconomic, and cultural resources and emergency planning and preparedness be considered explicitly in the site-specific EIS decision-making process.

22547 (ANL/EAIS/PP–76006) **A numerical solution to three-dimensional multiphase transport of volatile organic compounds in unsaturated soils – with an application to the remedial method of in-situ volatilization: Part I: Theoretical development.** Filley, T.; Tomasko, D. Argonne National Lab., IL (United States). Apr 1992. 46p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013391. Source: OSTI; NTIS; INIS; GPO Dep.

Part I of this paper presents the development and application of a numerical model for determining the fate and transport of volatile organic compounds (VOCS) in the unsaturated zone resulting from forced volatilization and gaseous advection-dispersion of organic vapor in a multipartitioned three-dimensional environment. The model allows for single-component transport in the gas and water phases. The hydrocarbon is assumed to be in specific retention and, therefore, immobile. Partitioning of the hydrocarbon between the oil, water, gas, and soil is developed as rate-limited functions that are incorporated into sink/source terms in the transport equations. The code for the model was developed specifically to investigate in-situ volatilization (ISV) remedial strategies, predict the extent of cleanup from information obtained at a limited number of measurement locations, and to help design ISV remedial systems. Application of the model is demonstrated for a hypothetical one-dimensional ISV system. Part II of this paper will present the analysis of an existing ISV system using the full three-dimensional capability of the model.

22548 (ANL/MCS/CP–82806) **Application of automatic differentiation to groundwater transport models.** Bischof, C.H.

(Argonne National Lab., IL (United States)); Ross, A.A.; Whiffen, G.J.; Shoemaker, C.A.; Carle, A. Argonne National Lab., IL (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant ASC 8915326; NCCW-0027; CCR-9120008; CCR-8809615. (CONF-940742–7: Computational methods in water resources, Heidelberg (Germany), 19-22 Jul 1994). Order Number DE94013331. Source: OSTI; NTIS; GPO Dep.

Automatic differentiation (AD) is a technique for generating efficient and reliable derivative codes from computer programs with a minimum of human effort. Derivatives of model output with respect to input are obtained exactly. No intrinsic limits to program length or complexity exist for this procedure. Calculation of derivatives of complex numerical models is required in systems optimization, parameter identification, and systems identification. We report on our experiences with the ADIFOR (Automatic Differentiation of Fortran) tool on a two-dimensional groundwater flow and contaminant transport finite-element model, ISOQUAD, and a three-dimensional contaminant transport finite-element model, TLS3D. Derivative values and computational times for the automatic differentiation procedure axe compared with values obtained from the divided differences and handwritten analytic approaches. We found that the derivative codes generated by ADIFOR provided accurate derivatives and ran significantly faster than divided-differences approximations, typically in a tenth of the CPU time required for the imprecise divided-differences method for both codes. We also comment on the impact of automatic differentiation technology with respect to accelerating the transfer of general techniques developed for using water resource computer models, such as optimal design, sensitivity analysis, and inverse modeling problems to field problems.

22549 (BNL–49681) **Hydraulic and hydrologic evaluation of PAR Pond Dam: Technical evaluation report.** Reich, M.; Wang, P.C.; Khanbilvardi, R.; Bezler, P. Brookhaven National Lab., Upton, NY (United States). Oct 1993. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94005432. Source: OSTI; NTIS; GPO Dep.

The PAR Pond Dam at Savannah River Plant was constructed in 1958–1959. Seepage, depressions, boils and spring flow were observed in varying locations on the dam in the last few years. Comprehensive geotechnical and hydraulic investigations pertaining to the effects of the above observations on the abilities of the dam to withstand future floods were made in 1991 and early 1993 where dam capacity to survive flooding and seismic events were evaluated. Brookhaven National Laboratory (BNL) was asked by the Department of Energy (EH) to carry out an independent review of the PAR Pond Dam response to future flooding and seismic events. This report addresses the studies made to evaluate the capacity of the dam to survive floods. A companion report will summarize the evaluations performed to assess the seismic capacity of the dam.

22550 (BNWL-CC–1670) **Waste disposal to the ground at 100-N.** Hajek, B.F. Pacific Northwest Lab., Richland, WA (United States). 31 Jul 1968. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94006962. Source: OSTI; NTIS; GPO Dep.

The objective of this document is to present information which can be used as an aid in determining the suitability of wastewater for ground disposal in the vicinity of the 100-N area. The material presented was obtained from a review of significant literature and from unpublished data from many soil-waste interaction studies conducted at Hanford. This information is not intended for use as criteria for ground disposal but rather as a guide in decision making within the framework of criteria based on all factors which must be considered before radioactive wastewater is disposed to the soil environment. The major sections of this document are: fundamentals, waste characteristics, and waste evaluation. The section on fundamentals discusses some theoretical concepts deemed necessary for a better understanding of radionuclide adsorption processes in soils. The section on waste characteristics is written in terms of specific radionuclides and nonradioactive competing ion effects. The waste evaluation section consists of an outline and brief explanation of how the material in this document can be used in the evaluation of suitability of wastewater for ground disposal.

22551 (CNIC–00749) **The behavior of ^{89}Sr and tritium water (HTO) in a model terrestrial-aquatic ecosystem.** Zhang Yongxi (Zhejiang Agricultural Univ., Hangzhou (China). Inst. of Nuclear-Agricultural Sciences); Wang Shouxiang; Chen Chuangqun; Sun Zhiming; Wang Fujun; Huang Dan; Hu Bingmin. China Nuclear Information Centre, Beijing, BJ (China). Aug 1993. 14p. (In Chinese). (CSNAS–0071.). Order Number DE94625868. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of land polluted by ^{89}Sr on water body and the immigration of HTO from water body to land were studied in a modelling terrestrial-aquatic ecosystem. The results are as follows: (1) The ^{89}Sr in soil quickly migrated to common bean plants and its concentration in common bean plants was increasing with the time, but the concentration of ^{89}Sr in soil was exponentially declining with the depth. About 5% of ^{89}Sr was migrated to water body by rainfall then distributed to other components, and it can be concentrated by aquatics in a certain degree. (2) when HTO entered into the water body, it would migrate to other components of the ecosystem. and the HTO in the pool was linearly decreasing with the time. However, the concentration of HTO in the sediments and aquatics would firstly increase then reached the peak and went down. The tritium of HTO was existed in two forms in the sediments and aquatics, free water (HTO) and bound tritium. HTO was also migrated to the adjacent land soil and absorbed by land crop plants, within one and half months the land system contained 24% of the total tritium in the aquatic system.

22552 (CONF-940401–9) **Methods for preparing comparative standards and field samples for neutron activation analysis of soil.** Glasgow, D.C.; Dyer, F.F.; Robinson, L. Oak Ridge National Lab., TN (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on methods and applications of radioanalytical chemistry; Kona, HI (United States); 10-16 Apr 1994. Order Number DE94012738. Source: OSTI; NTIS; INIS; GPO Dep.

One of the more difficult problems associated with comparative neutron activation analysis (CNAA) is the preparation of standards which are tailor-made to the desired irradiation and counting conditions. Frequently, there simply is not a suitable standard available commercially, or the resulting gamma spectrum is convoluted with interferences. In a recent soil analysis project, the need arose for standards which contained about 35 elements. In response, a computer spreadsheet was developed to calculate the appropriate amount of each element so that the resulting gamma spectrum is relatively free of interferences. Incorporated in the program are options for calculating all of the irradiation and counting parameters including activity produced, necessary flux/bombardment time, counting time, and appropriate source-to-detector distance. The result is multi-element standards for CNAA which have optimal concentrations. The program retains ease of use without sacrificing capability. In addition to optimized standard production, a novel soil homogenization technique was developed which is a low cost, highly efficient alternative to commercially available homogenization systems. Comparative neutron activation analysis for large scale projects has been made easier through these advancements. This paper contains details of the design and function of the NAA spreadsheet and innovative sample handling techniques.

22553 (CONF-940815–5) **Field demonstrations of passive detectors for screening of alpha contaminated soils.** Meyer, K.E.; Gammage, R.B.; Dudney, C.S. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International nuclear and hazardous waste management conference; Atlanta, GA (United States); 14-18 Aug 1994. Order Number DE94011467. Source: OSTI; NTIS; INIS; GPO Dep.

There are numerous sites around the country, DOE and otherwise, that are faced with the daunting task of remediating radiologically contaminated soils and groundwaters. Some of these sites, such as the Nevada Test Site and the Rocky Flats Plant, have contaminants that have been dispersed over wide areas. The

costs of the characterization phase alone for such remediation programs can be prohibitive. Therefore there are pressing needs for testing and evaluation of new technologies for screening for radiological contaminants that may offer significant advantages in capital costs, ease of use, sensitivity, ruggedness, and/or reliability. This work reports on laboratory and Field tests of two types of passive alpha detectors, electret ionization chambers (EIC's) and alpha track detectors (ATD's), that have been commercially developed for indoor radon measurements. Previous work documented calibration and measurement protocols developed for these detectors for indoor surface contamination measurements.

22554 (DOE/EA–0847) **Live Fire Range Environmental Assessment.** USDOE Central Training Academy, Albuquerque, NM (United States). Aug 1993. 66p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94010403. Source: OSTI; NTIS; GPO Dep.

The Central Training Academy (CTA) is a DOE Headquarters Organization located in Albuquerque, New Mexico, with the mission to effectively and efficiently educate and train personnel involved in the protection of vital national security interests of DOE. The CTA Live Fire Range (LFR), where most of the firearms and tactical training occurs, is a complex separate from the main campus. The purpose of the proposed action is to expand the LFR to allow more options of implementing required training. The Department of Energy has prepared this Environmental Assessment (EA) for the proposed construction and operation of an expanded Live Fire Range Facility at the Central Training Academy in Albuquerque, New Mexico. Based on the analysis in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969. Therefore, the preparation of an environmental impact statement is not required and DOE is issuing this Finding of No Significant Impact (FONSI).

22555 (DOE/EA–0893) **Strom Thurmond Biomedical Research Center at the Medical University for South Carolina Charleston, South Carolina.** USDOE Chicago Operations Office, Argonne, IL (United States). Feb 1994. 41p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013091. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) has prepared an Environmental Assessment (EA) evaluating the proposed construction and operation of the Strom Thurmond Biomedical Research Center (Center) at the Medical University of South Carolina (MUSC), Charleston, SC. The DOE is evaluating a grant proposal to authorize the MUSC to construct, equip and operate the lower two floors of the proposed nine-story Center as an expansion of on-going clinical research and out-patient diagnostic activities of the Cardiology Division of the existing Gazes Cardiac Research Institute. Based on the analysis in the EA, the DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of the NEPA. Therefore, the preparation of an Environmental Impact Statement is not required.

22556 (DOE/EH–0054) **Environment, Safety and Health Progress Assessment of the Argonne Illinois Site.** USDOE, Washington, DC (United States). Nov 1993. 290p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94005317. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the results of the US Department of Energy (DOE) Environment, Safety and Health (ES&H) Progress Assessment of the Argonne Illinois Site (AIS), near Chicago, Illinois, conducted from October 25 through November 9, 1993. During the Progress Assessment, activities included a selective review of the ES&H management systems and programs with principal focus on the DOE Office of Energy Research (ER); CH, which includes the Argonne Area Office; the University of Chicago; and the contractor's organization responsible for operation of Argonne National Laboratory (ANL). The ES&H Progress Assessments are part of DOE's continuing effort to institutionalize line management accountability and the self-assessment process throughout DOE and its contractor organizations. The purpose of the AIS ES&H Progress Assessment was to provide the Secretary of Energy, senior DOE managers, and contractor management with concise independent information on the following: change in culture and attitude related to ES&H activities; progress and effectiveness of the ES&H corrective actions resulting from the previous Tiger Team Assessment; adequacy and effectiveness of the ES&H self-assessment process of the DOE line organizations, the site management, and the operating contractor; and effectiveness of DOE and contractor management structures, resources, and systems to effectively address ES&H problems and new ES&H initiatives.

22557 (DOE/EH–0363) **Environmental Management Assessment of the National Renewable Energy Laboratory (NREL).** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Audit. Sep 1993. 150p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94007099. Source: OSTI; NTIS; GPO Dep.

This report documents the results of the environmental management assessment performed at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. The onsite portion of the assessment was conducted from September 14 through September 27, 1993, by DOE's Office of Environmental Audit (EH-24) located within the Office of the Assistant Secretary for Environment, Safety, and Health (EH-1). During this assessment, the activities conducted by the assessment team included reviews of internal documents and reports from previous audits and assessments; interviews with US Department of Energy (DOE) and NREL contractor personnel; and inspections and observations of selected facilities and operations. The environmental management assessment of NREL focused on the adequacy of environmental management systems and assessed the formality of programs employing an approach that recognizes the level of formality implementing environmental programs may vary commensurate with non-nuclear research and development operations. The Assessment Team evaluated environmental monitoring, waste management and National Environmental Policy Act (NEPA) activities at NREL, from a programmatic standpoint. The results of the evaluation of these areas are contained in the Environmental Protection Programs section of this report. The scope of the NREL Environmental Management Assessment was comprehensive and included all areas of environmental management. At the same time, environmental monitoring, waste management, and NEPA activities were evaluated to develop a programmatic understanding of these environmental disciplines, building upon the results of previous appraisals, audits, and reviews performed at the NREL.

22558 (DOE/MC/28162–3726) **Coolside waste management research: Technical progress report, October 1, 1993–October 31, 1993.** Kentucky Univ., Lexington, KY (United States). Research Foundation. [1994]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC28162. Order Number DE94012446. Source: OSTI; NTIS; GPO Dep.

A program for calculating speciation of elements in natural waters was adapted for use in this program. A public domain program, WATEQ4F, written in Fortran was selected. This program accesses a single input file and produces a single output file. Thereby, data obtained from the lysimeters can be manipulated to infer chemical species concentrations and the mineral phases present in the column environment. The original program was converted from Fortran to C and tested in DOS using WATEQ4F test case one. The result was modified to run under Windows 3.0/3.1 with menus with items and input screens, using Borland C++ v3.1. This program was debugged with all four test cases and is now called WATEQ to differentiate it from the 4F(Fortran) version.

22559 (DOE/MT/91003–T7-Attach.A) **State Assistance with Risk-Based Data Management: Inventory and needs assessment of 25 state Class II Underground Injection Control programs: Phase 1.** CH2M Hill, Reston, VA (United States); Digital Design Group, Inc. (United States). Jul 1992. 228p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91MT91003. Order Number DE94013188. Source: OSTI; NTIS; GPO Dep.

As discussed in Section I of the attached report, state agencies must decide where to direct their limited resources in an effort to make optimum use of their available manpower and address those

areas that pose the greatest risk to valuable drinking water sources. The Underground Injection Practices Research Foundation (UIPRF) proposed a risk-based data management system (RBDMS) to provide states with the information they need to effectively utilize staff resources, provide dependable documentation to justify program planning, and enhance environmental protection capabilities. The UIPRF structured its approach regarding environmental risk management to include data and information from production, injection, and inactive wells in its RBDMS project. Data from each of these well types is critical to the complete statistical evaluation of environmental risk and selected automated functions. This comprehensive approach allows state Underground Injection Control (UIC) programs to effectively evaluate the risk of contaminating underground sources of drinking water, while alleviating the additional work and associated problems that often arise when separate data bases are used. CH2M Hill and Digital Design Group, through a DOE grant to the UIPRF, completed an inventory and needs assessment of 25 state Class II UIC programs. The states selected for participation by the UIPRF were generally chosen based on interest and whether an active Class II injection well program was in place. The inventory and needs assessment provided an effective means of collecting and analyzing the interest, commitment, design requirements, utilization, and potential benefits of implementing a in individual state UIC programs. Personal contacts were made with representatives from each state to discuss the applicability of a RBDMS in their respective state.

22560 (DOE/MT/91003–T7-Attach.B) **Risk-Based Data Management System design specifications and implementation plan for the Alaska Oil and Gas Conservation Commission; the Mississippi State Oil and Gas Board; the Montana Board of Oil and Gas Conservation; and the Nebraska Oil and Gas Conservation Commission.** CH2M Hill, Reston, VA (United States); Digital Design Group, Inc. (United States). Sep 1993. 374p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91MT91003. Order Number DE94013189. Source: OSTI; NTIS; GPO Dep.

The purpose of this document is to present design specifications and an implementation schedule for the development and implementation of Risk Based Data Management Systems (RBDMS's) in the states of Alaska, Mississippi, Montana, and Nebraska. The document presents detailed design information including a description of the system database structure, data dictionary, data entry and inquiry screen layouts, specifications for standard reports that will be produced by the system, functions and capabilities (including environmental risk analyses), And table relationships for each database table within the system. This design information provides a comprehensive blueprint of the system to be developed and presents the necessary detailed information for system development and implementation. A proposed schedule for development and implementation also is presented. The schedule presents timeframes for the development of system modules, training, implementation, and providing assistance to the states with data conversion from existing systems. However, the schedule will vary depending upon the timing of funding allocations from the United States Department of Energy (DOE) for the development and implementation phase of the project. For planning purposes, the schedule assumes that initiation of the development and implementation phase will commence November 1, 1993, somewhat later than originally anticipated.

22561 (DOE/NV/10845–25) **A conceptual model and preliminary estimate of potential tritium migration from the Benham (U-20c) site, Pahute Mesa, Nevada Test Site.** Brikowski, T. (Nevada Univ., Reno, NV (United States). Water Resources Center); Mahin, G. USDOE Nevada Operations Office, Las Vegas, NV (United States); Nevada Univ., Reno, NV (United States). Water Resources Center. Aug 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE94012374. Source: OSTI; NTIS; INIS; GPO Dep.

U-20c is the site of a large below-water-table nuclear test near the Nevada Test Site boundary. A conceptual model of potential groundwater migration of tritium from U-20c is constructed and quantitatively evaluated in this report. The lower portion of the collapse chimney at Benham is expected to intersect 200 m of permeable rhyolite lava, overlain by similar thicknesses of low-permeability zeolitized bedded tuff, then permeable welded tuff. Vertical groundwater flow through the chimney is predicted to be minimal, horizontal transport should be controlled by the regional groundwater flow. Analytic solutions treating only advective transport indicate 1 to 2 km of tritium movement (95% confidence interval 0.7–2.5 km) within 5 years after test-related pressure-temperature transients have dissipated. This point lies at the axis of a potentiometric surface trough along the west edge of Area 20, Nevada Test Site. Within 25 years, movement is predicted to extend to 3 km (95% confidence interval 2–5 km) approximately to the intersection of the trough and the Nevada Test Site boundary. Considering the effects of radioactive decay, but not dispersion, plume concentration would fall below Safe Drinking Water Act standards by 204 years, at a predicted distance of 11 km (95% confidence interval 7–31 km). This point is located in the eastern portion of the Timber Mountain Caldera moat within the Nellis Air Force Range (military bombing range).

22562 (DOE/OR/22000–1) **Demonstration test and evaluation of Ultraviolet/Ultraviolet Catalyzed Peroxide Oxidation for Groundwater Remediation at Oak Ridge K-25 Site: Final report [March 16, 1993–March 16, 1994].** Schafer (W.J.) Associates, Inc., Chelmsford, MA (United States); Vulcan Peroxidation Systems, Inc., Tucson, AZ (United States). Mar 1994. 247p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-93OR22000. Order Number DE94013173. Source: OSTI; NTIS; INIS; GPO Dep.

We demonstrated, tested and evaluated a new ultraviolet (UV) lamp integrated with an existing commercial technology employing UV catalyzed peroxide oxidation to destroy organics in groundwater at an Oak Ridge K-25 site. The existing commercial technology is the perox-pure™ process of Peroxidation Systems Incorporated (PSI) that employs standard UV lamp technology to catalyze H_2O_2 into OH radicals, which attack many organic molecules. In comparison to classical technologies for remediation of groundwater contaminated with organics, the perox-pure™ process not only is cost effective but also reduces contaminants to harmless by-products instead of transferring the contaminants from one medium to another. Although the perox-pure™ process is cost effective against many organics, it is not effective for some organic contaminants of interest to DOE such as TCA, which has the highest concentration of the organics at the K-25 test site. Contaminants such as TCA are treated more readily by direct photolysis using short wavelength UV light. WJSA has been developing a unique UV lamp which is very efficient in the short UV wavelength region. Consequently, combining this UV lamp with the perox-pure™ process results in a means for treating essentially all organic contaminants. In the program reported here, the new UV lamp lifetime was improved and the lamp integrated into a PSI demonstration trailer. Even though this UV lamp operated at less than optimum power and UV efficiency, the destruction rate for the highest concentration organic (TCA) was more than double that of the commercial unit. An optimized UV lamp may double again the destruction rate; i.e., a factor of four greater than the commercial system. The demonstration at K-25 included tests with (1) the commercial PSI system, (2) the new UV lamp-based system and (3) the commercial PSI and new UV lamp systems in series.

22563 (EGG–11265-1010) **An in situ survey of the Paducah Gaseous Diffusion Plant and surrounding area.** Hoover, R.A. EG and G Energy Measurements, Inc., Goleta, CA (United States). Feb 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. Order Number DE94012408. Source: OSTI; NTIS; INIS; GPO Dep.

An in situ survey of the area surrounding the Paducah Gaseous Diffusion Plant was conducted between May 17 and 24, 1990. The survey consisted of in situ measurements and of ground sampling. A High Purity Germanium detector was used for the in situ measurements. The ground samples were taken to the, laboratory at EG&G Energy Measurements, Inc., in Santa Barbara, California, for a radionuclide assay on a laboratory system. Results of the in situ measurements found evidence of naturally occurring radioisotopes, cesium-137 from international fallout, and some evidence of anomalous uranium-238. The soil sampling results show only the

presence of naturally occurring radioisotopes, cesium-137, and also anomalous uranium-238.

22564 (EGG–11265-1062) **Effects of seedbed preparation, irrigation, and water harvesting of seedling emergence at the Nevada Test Site.** Winkel, V.K.; Ostler, W.K.; Gabbert, W.D.; Lyon, G.E. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Feb 1994. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-9310276–6: 8. wildland shrub and arid land restoration symposium, Las Vegas, NV (United States), 19-21 Oct 1993). Order Number DE94013549. Source: OSTI; NTIS; INIS; GPO Dep.

Approximately 800 hectares on the US Department of Energy Nevada Test Site and vicinity are contaminated with plutonium. As part of a cleanup effort, both the indigenous vegetation and the top 5–10 cm of soil may be removed, and the soil may or may not be replaced. Technologies must be developed to stabilize and revegetate these lands. A study was developed to determine adaptable plant species, methods to prepare seedbeds for direct seeding and water harvesting, and proper irrigation rates. Plots were cleared of indigenous vegetation, and then prepared with various seedbed/water harvesting treatments including, pitting, land imprinting, and mulching. Other plots were treated with large water harvesting structures. Three irrigation treatments were superimposed over the seedbed/water harvesting treatments. Seedling emergence data was collected, and the treatment combinations compared. Supporting meteorological and soil data were collected with an automatic data-logger. Specific data included precipitation, and air temperature. In a year of above-average precipitation, irrigation did not generally aid germination and emergence of seeded species, and only slightly increased densities of species from the native seedbank. With the exception of increased shrub seedling densities in desert strips, there were no strong seedbed preparation/water harvesting treatment effects. In years of above-average rainfall, mulching and water harvesting treatments, irrigation may not be necessary to insure adequate germination and emergence of adapted perennial grasses, forbs, and shrubs in the Mojave/Great Basin Transition Desert. Future collection of survival data will determine whether a maintenance irrigation program is necessary to ensure establishmnent of native plants.

22565 (EGG–11265-1063) **Evaluation of a new miniature temperature data logger: Herpetological review.** Mueller, J.M.; Rakestraw, D.L. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. Order Number DE94013561. Source: OSTI; NTIS; GPO Dep.

Peterson and Dorcas described the advantages of using data loggers to measure variation in the environment. We used a new, miniature temperature data logger to measure the temperatures of nests and hibernacula of desert tortoises (Gopherus agassizii). Here we report on the accuracy, reliability, and ease of use of these data loggers. Reference to a company or product name does not imply approval or recommendation of the product by the US Department of Energy to the exclusion of others that may be suitable. Quoted costs are from a published price list.

22566 (EGG–11265-1066) **Land reclamation on the Nevada Test Site: A field tour.** Winkel, V.K.; Ostler, W.K. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-9310276–5: 8. wildland shrub and arid land restoration symposium, Las Vegas, NV (United States), 19-21 Oct 1993). Order Number DE94012666. Source: OSTI; NTIS; INIS; GPO Dep.

An all-day tour to observe and land reclamation on the Nevada Test Site was conducted in conjunction with the 8th Wildland Shrub and Arid Land Restoration Symposium. Tour participants were introduced to the US Department of Energy reclamation programs for Yucca Mountain Site Characterization Project and Treatability Studies for Soil Media (TSSM) Project. The tour consisted of several stops that covered a variety of topics and studies including revegetation by seeding, topsoil stockpile stabilization, erosion control, shrub transplanting, shrub herbivory, irrigation, mulching, water harvesting, and weather monitoring.

22567 (EGG–11265-1236) **An aerial radiological survey of the Savannah River Site and surrounding area, Aiken, South Carolina, October–November 1991.** Vojtech, R.J. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Dec 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE94013362. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted during the period of October 14 to November 23, 1991, over an area surrounding the United States Department of Energy's Savannah River Site (SRS). The area is situated 15 kilometers south of Aiken, South Carolina. The purpose of the survey was to measure and document the gamma ray environment of the SRS and surrounding areas. Contour maps showing gamma radiation exposure rates at 1 meter above ground level were constructed from the aerial data and overlaid on a United States Geological Survey map of the area. The exposure rates measured within the survey region are generally uniform and typical of natural background. The reported exposure rate values include an estimated cosmic ray contribution. Enhanced exposure rates not attributable to natural background were measured over several areas within the survey region. The manmade radionuclides detected in these areas, cesium-137, cobalt-60, and protactinium-234m, were produced by the reactor operations and material processing conducted at the SRS. The radiation levels produced by these nuclides are consistent with those levels measured during previous SRS aerial surveys. Radionuclide assays of soil samples and pressurized ion chamber measurements were obtained at four locations within the survey boundaries.

22568 (EGG–11265-2036) **Species and community response to above normal precipitation following prolonged drought in the northern Mojave Desert.** Schultz, B.W. (Nevada Univ., Reno, NV (United States). Desert Research Inst.); Ostler, W.K. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-9310276–7: 8. wildland shrub and arid land restoration symposium, Las Vegas, NV (United States), 19-21 Oct 1993). Order Number DE94013571. Source: OSTI; NTIS; GPO Dep.

Little information is available on how desert plant communities that are dominated by perennial species respond to normal and above normal precipitation following prolonged drought. Intuitively, one would expect total canopy cover to increase. Whether a concomitant increase in the density of perennial species also occurs is unknown. Even less is known about how individual species respond to above normal precipitation following drought. From 1987 through 1991 a prolonged drought occurred in much of the western United States, including the northern Mojave Desert. In March 1991 the northern Mojave Desert received well above normal precipitation. The following two winters (December–March) also had above normal precipitation (150 to 200 % of normal, unpublished data). Ongoing vegetation characterization studies by the US Department of Energy (DOE) at Yucca Mountain, Nevada, allowed EG&G Energy Measurements to collect data that could be used to infer how both vegetation associations and individual species respond to above normal precipitation following prolonged drought. This paper reports the preliminary results.

22569 (EGG–11265-5018) **Nonintrusive subsurface surveying capability.** Tunnell, T.W.; Cave, S.P. EG and G Energy Measurements, Inc., Las Vegas, NV (United States). [1994]. 9p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-9404163–1: New Mexico Archeological Council spring meeting, Albuquerque, NM (United States), 29-30 Apr 1994). Order Number DE94012665. Source: OSTI; NTIS; GPO Dep.

This presentation describes the capabilities of a ground-pentrating radar (GPR) system developed by EG&G Energy Measurements (EM), a prime contractor to the Department of Energy (DOE). The focus of the presentation will be on the subsurface survey of DOE site TA-21 in Los Alamos, New Mexico. EG&G EM developed the system for the Department of Defense. The system is owned by the Department of the Army and currently resides at KO in Albuquerque. EM is pursuing efforts to transfer this

technology to environmental applications such as waste-site characterization with DOE encouragement. The Army has already granted permission to use the system for the waste-site characterization activities.

22570 (ENRESA–08/93) **Complementary programs for stochastic analysis of radionuclide transport.** Gomez Hernandez, J.J. Universidad Politecnica de Valencia (Spain). Dept. de Ingenieria Hidraulica y Medio Ambiente. 1993. 99p. (In Spanish). Order Number DE94770469. Source: OSTI; NTIS.

The present programs will permit to analyze the risks using parametric and non parametric technic. The programs are presented in two groups: (1) variable estimation through indicator krigeaje and variable estimation by Cokrigeaje (2) variable simulation with multi gassiness stochastic model and non gassiness. This report includes new programs for the non parametric geostatistics.

22571 (ENRESA–09/93) **Programs for the calculi of blocks permeabilities.** Gomez Hernandez, J.J.; Sovero Sovero, H.F. Universidad Politecnica de Valencia (Spain). Dept. de Ingenieria Hidraulica y Medio Ambiente. 1993. 115p. (In Spanish). Order Number DE94770470. Source: OSTI; NTIS.

This report studies the stochastic analysis of radionuclide transport. The permeability values of blocks are necessary to do a numeric model for the flux and transport problems in ground soils. The determination of block value by function on grill value is the objective of this program.

22572 (FEMP–2334) **Characterization of the vadose zone (Glacial tills).** Bishop, P. (Cincinnati Univ., OH (United States)); Allmon, L.A.; Broberg, K.A.; Hiestand, R.J. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. Mar 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-92OR21972. (CONF-9304242–Summ.: Fernald Environmental Management Project (FEMP) industrial workshop on characterization of the Vados Zone (Glacial Tills), Cincinnati, OH (United States), 15-16 Apr 1993). Order Number DE94009569. Source: OSTI; NTIS; GPO Dep.

The objectives of the workshop were to understand and assess the principles governing contaminant transport in glacial till, a medium that is strongly heterogeneous and anisotropic. The workshop acquainted the participants with the state of the art in understanding physical and chemical processes associated with contaminant transport in the vadose zone. While the scope of the workshop was comprehensive, the emphasis was placed on the role of sediment heterogeneity and anisotropy flow and transport processes. Each process was discussed in detail and was illustrated with case studies whenever possible so that the Fernald staff could benefit from the knowledge gained from earlier work. The intent of the workshop was to exchange new ideas and technologies. The strengths and weaknesses of current approaches and remedial techniques in dealing with glacial tills were explored. The workshop was structured to provide both theoretical and practical benefit to participants with diverse professional background.

22573 (INIS-BR–3319) **Adsorption and mobility of the herbicides 2,4-D and ametryn in soils of Sao Paulo State, Brazil.** Hermes, L.C. Centro de Energia Nuclear na Agricultura (CENA), Piracicaba, SP (Brazil). Feb 1991. 88p. (In Portuguese). Order Number DE94625870. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of different soil/water ratios on absorption of the herbicides 2,4-D (2,4-dichloro phenoxy-acetic acid) and ametryn (2, methyl thio-4-ethyl amino-6-isopropyl amino-s-triazine) was evaluated in 17 soil, under laboratory conditions, using ^{14}C compounds as tracers. The best regression equations and the variables that could explain the adsorption phenomenon were also determined for the soils studied. In another study, the mobility of both herbicides was determined by thin layer chromatography of the soils. (author).

22574 (INIS-BR–3330) **Computed tomography scanner applied to soil compaction studies.** Vaz, C.M.P. Sao Paulo Univ., Piracicaba, SP (Brazil). Escola Superior de Agricultura Luiz de Queiroz. Nov 1989. 126p. (In Portuguese). Order Number DE94625880. Source: OSTI; NTIS (US Sales Only); INIS.

The soil compaction problem was studied using a first generation computed tomography scanner (CT). This apparatus gets images of soil cross sections samples, with resolution of a few millimeters. We performed the following laboratory and field experiments: basic experiments of equipment calibrations and resolutions studies; measurements of compacted soil thin layers; measurements of soil compaction caused by agricultural tools; stress-strain modelling in confined soil sample, with several moisture degree; characterizations of soil bulk density profile with samples collected in a hole (trench), comparing with a cone penetrometer technique. (author).

22575 (INIS-mf–13808, pp. 45) **Cesium 137 depth profiles in soils of Styria (Austria) in.** Zeck, C. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik); Ninaus, W.; Meisel, S.; Mueller, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CESIUM 137/radionuclide migration; SOILS/cesium 137; AUSTRIA; DEPTH; SOILS; SPATIAL DISTRIBUTION

22576 (INIS-mf–14230) **Chemical bonds of lead, zinc, cadmium and copper in soils of the northern Eifel.** Mitteilungen zur Mineralogie und Lagerstaettenkunde, v. 36. Frey-Wehrmann, S.G. Technische Hochschule Aachen (Germany). Fakultaet fuer Bergbau, Huettenwesen und Geowissenschaften; Technische Hochschule Aachen (Germany). Lehrstuhl und Inst. fuer Mineralogie und Lagerstaettenlehre. Jul 1991. 237p. (In German). Order Number DE94774222. Source: OSTI; NTIS (US Sales Only); INIS.

Heavy metal distributions and chemical bands were investigated in selected soils in the norhtern Eifel. Apart from the chemical status of the soils and their basis metals, concentrations and bonding pattern of lead, zinc, cadmium and copper were determined by means of a sequential extraction process. The results provide a detailed picture of heavy metal pollution in this region. (orig.). 46 figs., 52 tabs.

22577 (INIS-mf–14251) **Geophysical examinations of deposits and old sites.** Geophysikalische Untersuchungen auf Deponien und Altlasten, v. 1. Technische Univ. Bergakademie Freiberg (Germany). Inst. fuer Geophysik. 1991. 82p. (In German). (CONF-9105447–: Round table discussion: Geophysical examinations of deposits and old sites, Freiberg in Sachsen (Germany), 16-17 May 1991). Order Number DE94774266. Source: OSTI; NTIS (US Sales Only); INIS.

Geomagnetic total field measurements by proton magnetometers with memories form the systematic exploration of suspected surfaces of old sites and old sites of an important, flexible and reasonably priced geophysical process. From experience, there are two important main applications. These are firstly the detailed work on location problems jointly with and supplementing multi-temporal evaluations of the air picture and secondly to locate iron in deposits. The particular advantage of geo-magnetics is that even in the most difficult measurement conditions, with the aid of the suitable analytical method evaluation, clear results and practically usable information can be obtained. In comparison with this, other high resolution methods of measurement, such as electromagnetic charting, for example (problem of integral anomaly pictures which cannot be evaluated) and geo-radar (loam covering, trickled water saturation) are limited to a considerably narrower measurement and evaluation spectrum in practical applications. (orig.)

22578 (Juel–2812) **Lysimeter experiments on the translocation of methabenzthiazuron and dissolved organic carbon in an orthic luvisol, construction of two climate measuring stations and investigations to validate the lysimeter system.** Puetz, T. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Radioagronomie; Bonn Univ. (Germany). Sep 1993. 248p. (In German). Order Number DE94773692. Source: OSTI; NTIS (US Sales Only); INIS.

To study the transfer of methabenzthiazuron into the soil solution and to investigate leaching in intensively cultivated orthic luvisol

soil, 248 and 264 mg m^{-2} phenyl-U-^{14}Cmethabenzthiazuron were applied to winter wheat in a w.p. 66.7% formulation by pre-emergence spraying in accordance with good agricultural practice on two lysimeters in November 1988. This corresponded to an application quantity of 3.7 and 4.0 kg ha^{-1} of Tribunil^{R}. To study the translocation of dissolved organic carbon (DOC) in an orthic luvisol, 631 g m^{-2} ^{14}C-labelled oat straw, corresponding to a practical application of 6-8 t ha^{-1}, was worked into the 0-5 cm of the soil of the third lysimeter in October 1988. After oat straw and methabenzthiazuron application, two suction candles were installed at each depth of 10, 20, 40 and 60 cm in two lysimeters for continuous soil solution sampling. (orig.)

22579 (LA-SUB–94-42) **1993 Northern goshawk inventory on portions of Los Alamos National Laboratory, Los Alamos, NM: Final report.** Sinton, D.T. (Colorado State Univ., Fort Collins, CO (United States). Dept. of Fishery and Wildlife Biology); Kennedy, P.L. Los Alamos National Lab., NM (United States); Colorado State Univ., Fort Collins, CO (United States). Dept. of Fishery and Wildlife Biology. [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013611. Source: OSTI; NTIS; GPO Dep.

Northern goshawks (Accipiter gentilis) (hereafter referred to as goshawk) is a large forest dwelling hawk. Goshawks may be declining in population and reproduction in the southwestern United States. Reasons for the possible decline in goshawk populations include timber harvesting resulting in the loss of nesting habitat, toxic chemicals, and the effects of drought, fire, and disease. Thus, there is a need to determine their population status and assess impacts of management activities in potential goshawk habitat. Inventory for the goshawk was conducted on 2,254 ha of Los Alamos National Laboratory (LANL) to determine the presence of nesting goshawks on LANL lands. This information can be incorporated into LANL's environmental management program. The inventory was conducted by Colorado State University personnel from May 12 to July 30, 1993. This report summarizes the results of this inventory.

22580 (LA-UR–94-1488) **Are leaf chemistry signatures preserved at the canopy level?.** Borel, C.C.; Gerstl, S.A.W. Los Alamos National Lab., NM (United States). [1994]. 12p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940891–2: IGARSS '94 conference, Seabrook, TX (United States), 8-12 Aug 1994). Order Number DE94011705. Source: OSTI; NTIS; GPO Dep.

Imaging spectrometers have the potential to be very useful in remote sensing of canopy chemistry constituents such as nitrogen and lignin. In this study under the HIRIS project the question of how leaf chemical composition which is reflected in leaf spectral features in the reflectance and transmittance is affected by canopy architecture was investigated. Several plants were modeled with high fidelity and a radiosity model was used to compute the canopy spectral signature over the visible and near infrared. We found that chemical constituent specific signatures such as absorptions are preserved and in the case of low absorption are actually enhanced. For moderately dense canopies the amount of a constituent depends also on the total leaf area.

22581 (LA-UR–94-1838) **Environmental radiation monitoring plan for depleted uranium and beryllium areas, Yuma Proving Ground.** Ebinger, M.H.; Hansen, W.R. Los Alamos National Lab., NM (United States). 11 May 1994. 87p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012144. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Radiation Monitoring Plan (ERM) discusses sampling soils, vegetation, and biota for depleted uranium (DU) and beryllium (Be) at Yuma Proving Ground (YPG). The existing ERM plan was used and modified to more adequately assess the potential of DU and Be migration through the YPG ecosystem. The potential pathways for DU and Be migration are discussed and include soil to vegetation, soil to animals, vegetation to animals, animals to animals, and animals to man. Sample collection will show DU deposition and will be used to estimate DU migration. The number of samples from each area varies and depends on if the firing range of interest is currently used for DU testing (GP 17A) or if the range is not used currently for DU testing (GP 20). Twenty to thirty-five individual mammals or lizards will be sampled from each transect. Air samples and samples of dust in the air fall will be collected in three locations in the active ranges. Thirty to forty-five sediment samples will be collected from different locations in the arroys near the impact areas. DU and Be sampling in the Hard Impact and Soft Impact areas changed only slightly from the existing ERM. The modifications are changes in sample locations, addition of two sediment transport locations, addition of vegetation samples, mammal samples, and air sampling from three to five positions on the impact areas. Analysis of samples for DU or total U by inductively-coupled mass spectroscopy (ICP/MS), cc spectroscopy, neutron activation analysis (NAA), and kinetic phosphorimetric analysis (KPA) are discussed, and analysis for Be by ICP/MS are recommended. Acquiring total U (no isotope data) from a large number of samples and analysis of those samples with relatively high total U concentrations results in fewer isotopic identifications but more information on U distribution. From previous studies, total U concentrations greater than about 3 times natural background are usually DU by isotopic confirmation.

22582 (LBL–35388) **Preliminary analysis of three-dimensional moisture flow within Yucca Mountain, Nevada.** Bodvarsson, G. (Lawrence Berkeley Lab., CA (United States)); Chen, G.; Wittwer, C. Lawrence Berkeley Lab., CA (United States). Mar 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940553–63: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94013097. Source: OSTI; NTIS; GPO Dep.

The continuous development of the three-dimensional site-scale model of Yucca Mountain Nevada is described. Three-dimensional moisture flow simulations are conducted, that show how the stratigraphic units and fault offsets and properties at Yucca Mountain create complex three-dimensional flow patterns. Even for a really uniform infiltration rates, these geological complexities result in large lateral flow components and often concentrated flow into the water table. When the major faults are assumed to act as capillary barriers, moisture buildup occurs close to the faults. Conversely, when the faults are assumed to readily absorb water and allow for vertical migration, lateral flow is greatly enhanced and relatively dry conditions are found in the rock matrix adjacent to the faults. These results suggest that careful observations of saturations and rock matrix conditions in rock masses near major faults may help determine the hydrological characteristics of the faults. The site-scale model has been used to predict conditions in wells UZ-16 and other wells, in order to investigate the predictive capabilities of the model. Gas flow and the Geothermal gradient have been incorporated into the model.

22583 (ORNL/ER–186) **Results of two- and three-dimensional groundwater flow modeling for the design criteria studies in Waste Area Grouping 6 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States); Ebasco Services, Inc., Oak Ridge, TN (United States). Dec 1993. 242p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; AC05-91OR21928. Order Number DE94009443. Source: OSTI; NTIS; INIS; GPO Dep.

This report combines results from 2-D and 3-D groundwater flow simulations. An overview of the hydrogeologic setting of WAG 6 located at ORNL is presented followed by a discussion of the numerical models used. Model development is discussed for both the 3-D and 2-D models. Results are then presented for the 3-D models followed by results from the 2-D models. The report concludes with an integrated summary of conclusions. This report contains many figures because graphics are advantageous in effectively portraying modeling results.

22584 (ORNL/RASA–93/8) **Radiological re-survey results at 146 West Central Avenue, Maywood, New Jersey (MJ034).** Murray, M.E.; Johnson, C.A. Oak Ridge National Lab., TN (United States). May 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94013195. Source: OSTI; NTIS; INIS; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from 1916 to 1959. During the early years of operation, MCW stored wastes and residues in low-lying areas west of the processing facilities and consequently some of the residuals containing radioactive materials migrated offsite to the surrounding area. Subsequently, the U.S. Department of Energy (DOE) designated for remedial action the old MCW property and several vicinity properties. Additionally, in 1984, the property at 146 West Central Ave., Maywood, New Jersey and properties in its vicinity were included as a decontamination research and development project under the DOE Formerly Utilized Sites Remedial Action Program. In 1987 and 1988, at the request of DOE, Oak Ridge National Laboratory (ORNL) conducted a radiological survey on this property. A report describing this survey was published in 1989. A second radiological survey by ORNL was conducted on this property in May 1993 at the request of DOE after an ad hoc radiological survey, requested by the property owner and conducted by Bechtel National, Inc. (BNI), identified some contamination not previously found by ORNL. The purpose of the second ORNL survey was to determine whether radioactive materials from the old MCW were present on the property, and if so, if radioactive materials present were above guidelines. A certified civil survey was requisitioned by ORNL to determine actual property boundaries before beginning the radiological re-survey. The re-survey included a surface gamma scan and the collection of a large number of soil samples for radionuclide analyses. Results of this survey demonstrated that although elevated residual thorium-232 contamination was present in a few isolated spots on the southern end of the backyard, it did not exceed DOE guidelines.

22585 (PNL–9000-Pt.2) **Pacific Northwest Laboratory annual report for 1993 to the DOE Office of Energy Research: Part 2: Environmental sciences.** Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 104p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013453. Source: OSTI; NTIS; INIS; GPO Dep.

This 1993 Annual Report from Pacific Northwest Laboratory (PNL) to the US DOE describes research in environment and health conducted during fiscal year (FY) 1993. The report is divided into four parts, each in a separate volume. This part, Volume 2, covers Environmental Sciences. The research is directed toward developing a fundamental understanding of subsurface and terrestrial systems as a basis for both managing these critical resources and addressing environmental problems such as environmental restoration and global change. There are sections on Subsurface Science, Terrestrial Science, Technology Transfer, Interactions with Educational Institutions, and Laboratory Directed Research and Development.

22586 (PNL–9458) **Acute environmental toxicity and persistence of BIS (2-ethylhexyl) phosphonate: A chemical agent simulant.** Cataldo, D.A.; Ligotke, M.W.; McVeety, B.D.; Fellows, R.J.; Li, S.W.; Van Voris, P. Pacific Northwest Lab., Richland, WA (United States). May 1994. 79p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013747. Source: OSTI; NTIS; GPO Dep.

The present studies were undertaken to evaluate the environmental fate and effects of bis(2-ethylhexyl) phosphonate (BIS). Using air concentrations of 255 and 2350 mg BIS/m^3, mass loading and deposition velocities were determined for soils and foliar surfaces. Minimal contact toxicity was noted for sagebrush, tall fescue, and short-needle pine. All physiological indicators studied in response to BIS exposure were transient. Impacts to soil microbial processes were transient. The persistence of BIS in soils and on foliar surfaces was determined.

22587 (PNL–9791) **Estimation of the release and migration of nickel through soils and groundwater at the Hanford Site 218-E-12B Burial Ground.** Rhoads, K. (and others); Bjornstad, B.N.; Lewis, R.E. Pacific Northwest Lab., Richland, WA (United States). May 1994. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013959. Source: OSTI; NTIS; INIS; GPO Dep.

An assessment was performed to evaluate release and transport of nickel from large metal components containing nickel-bearing alloys at the Hanford Site 218-E-12B Burial Ground. The potential for nickel within the components to enter groundwater under the burial site was investigated by examining available data on the site's geology, geochemistry, and geohydrology to develop a conceptual model for release and transport of nickel from the components. In addition, laboratory studies were performed to provide information needed for the model, but which was not available from existing databases. Estimates of future concentrations of nickel radioisotopes (^{59}Ni and ^{63}Ni) and total elemental nickel in the unconfined aquifer and in the Columbia River were developed based on this information.

22588 (PNL–9815) **Tier I ecological evaluation for phase III channel improvements to the John. F. Baldwin ship channel.** Bienert, R.W. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Shreffler, D.K.; Word, J.Q.; Kohn, N.P. Pacific Northwest Lab., Richland, WA (United States). May 1994. 111p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013715. Source: OSTI; NTIS; GPO Dep.

To assist the US Army Corps of Engineers (USACE) in determing whether the material from proposed dredging of the John F. Baldwin Ship Channel (JFBSC) is suitable for unrestricted, unconfined open-ocean disposal, Battelle/Marine Sciences Laboratory (MSL) prepared this report. Based on these findings, sediments that would be removed during Phase III improvements to the JFBSC fail to meet the three suitability criteria for open-ocean disposal. Firstly, fine-grained sediments comprise a significant fraction of the bottom material in some areas of the channel, and this material is not exposed to high current or wave energy. Dredged material from the JFBSC is not being proposed for beach nourishment; therefore the second criterion is not met. JFBSC sediments do not meet the third criterion because, although they may be substantially similar to substrates at several of the proposed disposal sites, they are from an area that historically has experienced loading of contaminants, which toxicology studies have shown have the potential to result in acute toxicity or significant bioaccumulation.

22589 (PNL-SA–23165) **Responses of big sagebrush and spiny hopsage to increasing water stress.** Link, S.O. (Pacific Northwest Lab., Richland, WA (United States)); Thiede, M.E.; Downs, J.L.; Gee, G.W.; Evans, R.D. Pacific Northwest Lab., Richland, WA (United States). Oct 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9310276–4: 8. wildland shrub and arid land restoration symposium, Las Vegas, NV (United States), 19-21 Oct 1993). Order Number DE94011674. Source: OSTI; NTIS; GPO Dep.

Ecophysiological observations were taken on big sagebrush (Artemisia tridentata ssp. tridentata) and spiny hopsage (Grayia spinosa) to assess their response to increasing seasonal water stress. Non-destructive whole plant leaf area measurements indicated that big sagebrush produced more leaf area than spiny hopsage. Stem diameter dynamics revealed similar patterns for both species with diameter increases in the spring and shrinkage in the summer. The final stem diameter increase was greater for big sagebrush than spiny hopsage. Xylem pressure potential values were much lower by summer for spiny hopsage than for big sagebrush. Net photosynthesis, stomatal conductance and transpiration were maximal in the spring and declined thereafter for both species.

22590 (PNL-SA–23480) **Comparison of ground-derived and satellite-derived surface energy fluxes from a shrub-steppe site.** Kirkham, R.R. (Pacific Northwest Lab., Richland, WA (United States)); Gee, G.W.; Fritschen, L.J. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940362–2: 21. American Meteorological Society conference on agricultural and forest meteorology, San Diego, CA (United States), 7-10 Mar 1994). Order Number DE94011236. Source: OSTI; NTIS; GPO Dep.

Efforts to measure evapotranspiration (ET) remotely are common in agriculture, and the application of such data to irrigation scheduling is readily apparent. Extending this methodology to arid

environments is primarily of use as a mechanism for validation of ET algorithms used in large-scale watershed and global climate change modeling efforts. To facilitate testing of the remote sensing method for ET, measurements of sensible and latent heat flux were made at four sites located on the US Department of Energy's Hanford Site using a combination of lysimeter and Bowen Ratio Energy Balance (BREB) stations. The objective was to calibrate an aerodynamic transport equation that relates sensible heat flux to radiant surface temperature, and to map sensible heat flux using Landsat data.

22591 (SAND–93-1660C) **Natural responses to Quaternary climatic change in the Nevada Test Site region.** Gibson, J.D. Sandia National Labs., Albuquerque, NM (United States). [1993]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9304132–2: 1993 CAQUA semi-annual meeting, Victoria (Canada), 18-21 Apr 1993). Order Number DE94013773. Source: OSTI; NTIS; INIS; GPO Dep.

Migration of hazardous contaminants within geologic settings depends on natural processes. Climatic fluctuations can affect the magnitudes and rates of many of these processes. In any long-term environmental evaluation of natural processes, responses to climatic change must be considered. Four generalized categories of natural responses to Quaternary climatic change are recognized for the Nevada Test Site (NTS) region of southwestern Nevada and adjacent California: (1) biologic, (2) geomorphic, (3) hydrologic (including surface and subsurface) and (4) pedologic/diagenetic. Specific examples that correspond to the four categories illustrate the broad range of complex natural processes the are affected by climatic change. These responses dictate the potential effects of climatic change on contaminant transport, effects that are being examined by existing and planned environmental-restoration and waste-management programs within the region. Regulatory requirements for many of these programs include long-term (>10,000-year) waste isolation because of radiologic components. The purpose here is not to be exhaustive in documenting all known natural responses to climatic change in the NTS region, but rather to give a flavor of the scope of interdisciplinary and interrelated fields of Quaternary science that must be considered in evaluating the possible effects of climatic change on long-term environmental programs.

22592 (UBA-FB–92-105) **Selection of reference soils for chemicals testing in the European Community.** Kuhnt, G.; Hertling, T.; Schmotz, W.; Vetter, L.; Fraenzle, M.; Geissler, S.; Knabe, I.; Maass, R.; Struckmeyer, A.; Heinrich, U. Umweltbundesamt, Berlin (Germany); Kiel Univ. (Germany). Geographisches Inst. 1 Nov 1991. 180p. (In German). Sponsored by Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Contract UFOPLAN 10602058. Order Number DE94774256. Source: OSTI; NTIS (US Sales Only); INIS.

Based on an multivariate statistical evaluation of binary and metric data relating to the soil cover of the European Community five regionally representative reference soils (EURO-Soils) have been identified for chemicals testing in the EC. The soil material sampled at representative localities in Italy, Greece, Great Britain, France and Germany was treated and prepared according to OECD Test Guideline 106 and analysed in detail. The homogenised specimens were subject to an EC-wide ring test to evaluate the feasibility of the modified guideline and to validate the physical-chemical amenability of the reference soils for sorption tests. The results proved the validity of the soils selected for assessing the potential behaviour of new chemicals in soil on the basis of a comparative evaluation of the individual test results obtained. In the light of this parametric assessment potential test soils were subsequently identified in the individual EC Member States which correspond as far as possible to the above reference soils in terms of both taxonomy and sorption-relevant properties. (orig.). 164 refs., 30 tabs., 24 figs.

22593 (UCRL-ID–116122) **Preliminary on the isotope hydrology investigations at the Nevada test site: Hydrologic resources management program: FY 1992–1993.** Davisson, M.L.; Kenneally, J.M.; Smith, D.K.; Hudson, G.B.; Nimz, G.J.; Rego, J.H. Lawrence Livermore National Lab., CA (United States). Jan 1994. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94011538. Source: OSTI; NTIS; GPO Dep.

A comprehensive isotope data base of the NTS groundwaters collected during FY 92-93 is presented with preliminary interpretations. Multiple samples were collected from over 30 sites on pumped wells and open-holes by wireline bailing. Field water level measurements indicate essentially a bimodal distribution separated by water levels at higher elevations (e.g. Pahute Mesa) from water levels of lower elevations (e.g. Yucca and Frenchman Flats). Down hole temperature measurements have confirmed anomalous temperature gradients in the eastern Yucca Flat area and on Pahute Mesa, where horizontal temperature gradients up to 0.33°F/100ft are found. Consistent with previous reports by others, the major ion geochemistry of the NTS groundwater are dominated by Na-K-HCO_3 and Ca-Mg-HCO_3 water types, where the Na-rich water appears to be related to dissolution in the volcanic tuffs and the Ca-rich water to the Paleozoic carbonates. Increases in dissolved Si also seems to be indicative of groundwater that resides in the volcanic tuffs. Processes controlling the Na/Ca ratios are complex and may include ion exchange reactions with clays, evaporative concentration in the vadose zone, and lithological heterogeneities in addition to simple differential dissolution between the volcanic tuffs and the Paleozoic carbonates. Apparent ^{14}C ages range between 4000 and 38,000 years for groundwaters at the NTS. The uncertainty is large for exact age determinations at this time. The ^{14}C abundance decreases with increased dissolved HCO_3, and ^{13}C suggests dissolution of the "dead" Paleozoic carbonates significantly influence the ages, but more work is needed to investigate the influence of vadose zone carbonate.

22594 (UCRL-ID–116129) **New observations of infiltration through fractured alluvium in Yucca Flat, Nevada Test Site: A preliminary field investigation.** Kao, C.S. (California Univ., Berkeley, CA (United States). Dept. of Civil Engineering); Smith, D.K.; McKinnis, W.B. Lawrence Livermore National Lab., CA (United States). Feb 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012589. Source: OSTI; NTIS; GPO Dep.

Regional tectonics coupled with the subsurface detonation of nuclear explosives has caused widespread fracturing of the alluvium of Yucca Flat. Fractures deeper than 30 meters have been observed in boreholes. Some of these fractures are large enough to capture significant amounts of runoff during storm events. Evidence of stream capture by fractures and observations of runoff flowing into open fractures give qualitative evidence of infiltration to depths greater than several meters and possibly to the saturated zone. Our field observations contradict the assumption that little infiltration occurs on Yucca Flat. The larger, hydrologically important fractures are associated with geologic faults or the regional stress field. Additional field studies are needed to investigate the impact of fractures on the transport of contaminants.

22595 (UCRL-ID–116133) **FY-92 report on the isotope hydrology characterization of the Faultless test site, Nye County, Nevada.** Davisson, M.L.; Nimz, G.J.; Hudson, G.B.; Smith, D.K.; Rego, J.H.; Kenneally, J.M. Lawrence Livermore National Lab., CA (United States). Feb 1994. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94007760. Source: OSTI; NTIS; GPO Dep.

In January of 1968 the Faultless test shot at 975m below the surface had an estimated magnitude range between 200kt to 1Mt. The detonation resulted in a surface crater estimated at 1km in diameter accompanied by a > 3m collapse escarpment at the surface. Careful monitoring of outlying observation wells before, during and after the shot has provided valuable data on the hydrodynamic response of the groundwater. This report of FY92 investigations at Faultless by the Nuclear Chemistry Division at LLNL serves to outline new and previous isotopic data of natural and shot-related nuclides measured in the drillback hole and the two closest satellite wells. The goals of this study are: (1) to investigate and characterize the geochemical and isotopic variabilities of groundwater, as a function of groundwater source and age, (2) to determine concentrations of event-related nuclide activity and investigate any possible migration of the hydrologic source term. A more comprehensive source and age characterization from isotopic

and geochemical variations of natural groundwater in the Hot Creek Valley would require a regional scale investigation.

22596 (UCRL-JC–115344) **The development of a versatile field program for measuring tritium in real-time.** Rego, J.H.; Smith, D.K. Lawrence Livermore National Lab., CA (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940401–13: International conference on methods and applications of radioanalytical chemistry, Kona, HI (United States), 10-16 Apr 1994). Order Number DE94013241. Source: OSTI; NTIS; INIS; GPO Dep.

Robust sample handling and liquid scintillation counting procedures have been developed to routinely monitor tritium in the field relative to the 20,000 pCi/L drinking water standard. This procedure allows tritium to be monitored hourly during 24 hour drilling operations at depths in the saturated zone potentially contaminated by sub-surface nuclear weapons testing at the Nevada Test Site. Using retrofitted shock hardened and vibration damped counters and strict analytical protocols, tritium may be measured rapidly in the field under hostile conditions. Concentration standards and "dead" tritium backgrounds are prepared weekly in a central laboratory and delivered to remote monitoring locations where they are recounted daily as a check on counter efficiency and calibration. Portable counters are located in trailers and powered off a battery pack and line filter fed by mobile generator. Samples are typically ground-waters mixed with drilling fluids returned after circulation through a drill string. Fluids are aerated and "de-foamed," filtered, mixed with scintillation cocktail and subsequently dark-adapted before counting. Besides meeting regulatory requirements, "real-time" monitoring affords drilling and field personnel maximum protection against potential exposure to radionuclides; for routine operations, tritium activities may not exceed a 10,000 pCi/L threshold.

22597 (WHC-SD-EN-AP–117) **In-well vapor stripping drilling and characterization work plan.** Koegler, K.J. Westinghouse Hanford Co., Richland, WA (United States). 13 Mar 1994. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012937. Source: OSTI; NTIS; INIS; GPO Dep.

This work plan provides the information necessary for drilling, sampling, and hydrologic testing of wells to be completed in support of a demonstration of the in-well vapor stripping system. The in-well vapor stripping system is a remediation technology designed to preferentially extract volatile organic compounds (VOCs) from contaminated groundwater by converting them to a vapor phase. Air-lift pumping is used to lift and aerate groundwater within the well. The volatiles escaping the aerated water are drawn off by a slight vacuum and treated at the surface while the water is allowed to infiltrate the vadose zone back to the watertable.

22598 (WHC-SD-EN-DP–082) **Borehole completion data package for well 199-N-81.** Hartman, M.J. Westinghouse Hanford Co., Richland, WA (United States). 5 May 1994. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012933. Source: OSTI; NTIS; INIS; GPO Dep.

Well 199-N-81 was drilled in 1993 as a RCRA groundwater monitoring for the 1324-N network. The well is completed at the top of the uppermost aquifer, in the Ringold Formation. This data package includes information on drilling, construction, development, and aquifer testing. Copies of forms, notes, and diagrams completed in the field comprise the bulk of this document. Few interpretations are included. Lithologic contacts were picked by the site geologist. An attempt was made to interpret aquifer test data.

22599 (WHC-SD-EN-TP–038) **Aquifer test plan for two wells at the proposed C-018H disposal site.** Swanson, L.C. Westinghouse Hanford Co., Richland, WA (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94008076. Source: OSTI; NTIS; GPO Dep.

Aquifer testing will be conducted at groundwater monitoring well No. 3 at the proposed State-Approved Land Disposal Site (SALDS) north of the 200 West Area. Hydrologic testing will consist of instantaneous slug tests and constant rate discharge tests in a "drill-and-test" type sequence. Well No. 2 will be installed as a shallow groundwater monitoring well prior to testing, and used as an observation well during the constant rate discharge tests at well No. 3. Pumping tests will be performed at two to three intervals during the drilling process at well No. 3. Aquifer test results (hydraulic conductivities) will be used to refine estimates of groundwater travel time from the SALDS to the Columbia River. The SALDS location was selected because it provides the longest travel time to the Columbia River, allowing sufficient time for the tritium to decay to acceptable levels before entering the river.

22600 (WSRC-MS–94-0233) **Application of optical and thermal imagery to detect oil contaminated soil.** Pendergast, M.M. (Weirich and Associates (United States)); Nalezny, C.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940536–1: 10. conference on geologic remote sensing: exploration, environment and engineering, San Antonio, TX (United States), 9-12 May 1994). Order Number DE94011166. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy, Office of Environmental Restoration and Waste Management, Office of Technology Development, is evaluating the use of remote sensing to identify, characterize, and monitor waste sites at DOE facilities. This paper reports on the results of a study to determine under what conditions, and for how long, oil contaminated soil can be detected optically and thermally. The study site was the Oil Test Site at the Savannah River Site at Aiken, SC. The Oil Test Site was created in 1975 to investigate biodegradation of oil as an economical means of disposing of waste oil and solvents. In that investigation, about 18,000 liters of waste oil and solvents were applied in varying amounts to 27 rectangular plots. The goal of the research was to determine the effects of fertilizer on biodegradation of oil and solvents. The oil test site was monitored regularly for 5 years, during which time most of the oil and solvents degraded. The site remains intact today and provides an ideal means for testing remote sensing methods for detecting oil and solvent contaminated surface soil. Ground based solar reflectance spectra, ground-based laser induced fluorescence spectra, and surface temperature measurements were used to characterize the oil contaminated plots and control test plots for comparison with remote sensing data.

22601 (WSRC-TR–94-008) **F- and H-Area Sewage Sludge Application Sites groundwater monitoring report: Fourth quarter 1993 and 1993 summary.** Westinghouse Savannah River Co., Aiken, SC (United States). Apr 1994. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013659. Source: OSTI; NTIS; INIS; GPO Dep.

Samples from the four wells at the F-Area Sewage Sludge Application Site (FSS wells) and the three wells at the H-Area Sewage Sludge Application Site (HSS wells) are analyzed quarterly for constituents as required by South Carolina Department of Health and Environmental Control Construction Permit 12,076 and, as requested, for other constituents as part of the Savannah River Site (SRS) Groundwater Monitoring Program. Annual analyses for other constituents, primarily metals, also are required by the permit. No constituent exceeded either the final Primary Drinking Water Standards or the SRS Flag 2 criteria during fourth quarter 1993. Iron, lead, and manganese were the only permit- required analytes that exceeded standards at the F- and H-Area Sewage Sludge Application Sites in 1993. Tritium, aluminum, and other constituents not included in the permit have exceeded standards at this site previously, but only sporadically. These constituents were not analyzed fourth quarter 1993.

22602 (WSRC-TR–94-009) **K-Area and Par Pond Sewage Sludge Application Sites Groundwater Monitoring Report: Fourth quarter 1993 and summary 1993.** Westinghouse Savannah River Co., Aiken, SC (United States). Apr 1994. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013660. Source: OSTI; NTIS; INIS; GPO Dep.

Samples from the three wells at the K-Area Sewage Sludge Application Site (KSS wells) and the three wells at the Par Pond Sewage Sludge Application Site (PSS wells) are analyzed quarterly for constituents required by South Carolina Department of Health

and Environmental Control Construction Permit 13,173 and, as requested, for other constituents as part of the Savannah River Site (SRS) Groundwater Monitoring Program. Annual analyses for other constituents, primarily metals, also are required by the permit. Dichloromethane (methylene chloride) exceeded the final Primary Drinking Water Standard in a single well of the K-Area Sewage Sludge Application Site during fourth quarter 1993. Aluminum, iron, and lead, reported in excess of the SRS Flag 2 criteria at both the K-Area and Par Pond Sewage Sludge Application Sites during third quarter 1993, were not analyzed fourth quarter.

22603 (WSRC-TR–94-011) **H-Area Acid/Caustic Basin Groundwater Monitoring Report: Fourth quarterly report and summary 1993.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012930. Source: OSTI; NTIS; INIS; GPO Dep.

The four monitoring wells at the H-Area Acid/Caustic Basin are sampled quarterly as part of the Savannah River Site (SRS) Groundwater Monitoring Program and to comply with a consent decree signed May 26, 1988, by the US District Court (District of South Carolina, Aiken Division). During fourth quarter 1993, samples from the monitoring wells received comprehensive analyses. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS), the SRS flagging criteria, or the SRS turbidity standard are the focus of this report. During fourth quarter 1993, tritium exceeded the final PDWS in all four HAC wells, with activities between 3.8E + 01 and 4.6E + 01 pCi/mL. Aluminum exceeded its Flag 2 criterion in wells HAC 2, 3, and 4. Iron exceeded its Flag 2 criterion in wells HAC 1, 2, and 3. Specific conductance was elevated in well HAC 2, total organic halogens exceeded its Flag 2 criterion in wells HAC 2 and 3, and manganese was elevated in wells HAC 3 and 4. No well samples exceeded the SRS turbidity standard.

22604 (WSRC-TR–94-012) **K-Area Acid/Caustic Basin groundwater monitoring report: Fourth quarterly 1993 and 1993 summary.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012931. Source: OSTI; NTIS; INIS; GPO Dep.

During fourth quarter 1993, samples from the KAC monitoring wells at the K-Area Acid/Caustic Basin were collected and analyzed for indicator parameters, groundwater quality parameters, parameters indicating suitability as drinking water, and other constituents. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are discussed in this report. Tritium exceeded its final PDWS in well KAC 7 during fourth quarter 1993. The tritium value reported by the laboratory was approximately fifty times the concentration of any previous sample from that well. The well was resampled and yielded a low, historically-consistent tritium concentration. Therefore, the high tritium value reported this quarter is believed to be the result of a laboratory error. Aluminum exceeded its Flag 2 criterion in wells KAC 6, 7, and 9. Iron exceeded the Flag 2 criterion in well KAC 6, and specific conductance exceeded the Flag 2 criterion in well KAC 9. Total organic halogens exceeded standards in wells KAC 4 and 6. No samples exceeded the SRS turbidity standard.

22605 (WSRC-TR–94-014) **P-Area Acid/Caustic Basin Groundwater Monitoring Report: Fourth quarterly report and summary 1993.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012929. Source: OSTI; NTIS; INIS; GPO Dep.

During fourth quarter 1993, samples from the six PAC monitoring wells at the P-Area Acid/Caustic Basin were collected and analyzed for indicator parameters, groundwater quality parameters, parameters characterizing suitability as a drinking water supply, and other constituents. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are discussed in this report. During fourth quarter 1993, no constituents exceeded the final PDWS. Aluminum and iron exceeded the SRS Flag 2 criteria in five wells. Manganese exceeded its Flag 2 criterion in three wells, while specific conductance exceeded its Flag 2 criterion in one well.

22606 (WSRC-TR–94-030) **Innovative in situ treatment approach selected for the Department of Energy Savannah River Site Sanitary Landfill.** Suer, A. (Westinghouse Savannah River Co., Aiken, SC (United States)); Knapp, J. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94006649. Source: OSTI; NTIS; INIS; GPO Dep.

The Savannah River Site Sanitary Landfill is an approximate 70-acre site. In 1974, it was a 32-acre site receiving solid waste from a variety of sources. In 1987, the original area reached its capacity and a 16-acre northern expansion and a 22-acre southern expansion were added. The southern expansion is nearing capacity, and the northern expansion opened in 1993. During its operation, the Sanitary Landfill received rags and wipes used with F-listed solvents. In 1988, the Sanitary Landfill became the subject of a RCRA facility investigation and was designated a RCRA solid waste management unit because of recurring evidence of RCRA hazardous constituents in the groundwater. DOE and SCDHEC reached a settlement agreement, outlining the steps DOE would take to comply with RCRA regulations. Principally, DOE would close the portions of the, landfill containing the solvent rags. This paper describes the technology selection process conducted for the SRS Sanitary Landfill site and the innovative in situ treatment alternative selected for the groundwater and the vadose zone associated with the landfill.

22607 (WSRC-TR–94-0169) **TNX-Area groundwater monitoring report: 1993 Annual report.** Westinghouse Savannah River Co., Aiken, SC (United States). May 1994. 363p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012939. Source: OSTI; NTIS; INIS; GPO Dep.

During 1993, samples from well cluster P 26 and the TBG, TNX, XSB, and YSB well series at the TNX Area were analyzed for selected heavy metals, indicator parameters, radionuclides, volatile organic compounds, and other constituents. Seven parameters exceeded the final Primary Drinking Water Standards (PDWS). Dichloromethane (methylene chloride), a common laboratory contaminant, nitrate, and trichloroethylene exceeded PDWS most frequently. Four wells in this area currently are part of the Purge Water Contaminant Program due to high trichloroethylene concentrations. Carbon tetrachloride, gross alpha, lead, and tetrachloroethylene were elevated sporadically in one or more wells during the year. Groundwater flow directions and rates in the Unconfined Aquifer were similar from quarter to quarter during the year.

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Refer also to citation(s) 20849, 20953, 20999, 21049, 21052, 21077, 21118, 21133, 21384, 21385, 21386, 21388, 21696, 22491, 22505, 22508, 22520, 22539, 22543, 22550, 22554, 22587, 22677, 22720, 22721, 22723

22608 (DOE/BP–2314) **Information on SOR Draft EIS technical appendices: A guide to contents of the appendices and how to order them.** USDOE Bonneville Power Administration, Portland, OR (United States). Apr 1994. 11p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013390. Source: OSTI; NTIS; GPO Dep.

This brochure provides information on the various appendices to the System Operation Review (SOR) Draft Environmental Impact Statement (EIS). This information should help you decide which of the 19 appendices to request for review and comment. The appendices collectively are approximately 3500 pages long and as such represent a significant amount of information. They are the raw materials from which the summary and Draft EIS are prepared.

22609 (DOE/ER/60882–2) **Dynamics of recruitment-subsidized populations: Final report, 15 July 1989–14 July 1992.** Caswell, H. Woods Hole Oceanographic Institution, MA

(United States). 31 Oct 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER60882. Order Number DE94013786. Source: OSTI; NTIS; GPO Dep.

This final report briefly describes progress gained in four areas. These are the development of a frequency-response model for the density-independent dynamics of stage classified recruitment-subsidized populations; effects of density on growth rates in benthic invertebrates; larval subsidy; and consideration of individual-based models.

22610 (DOE/ER/60885–T2) **[Development and testing of theories of population dynamics]: First annual report.** Murdoch, W.W.; Bence, J.R.; McCauley, E.; Nisbet, R.M. California Univ., Santa Barbara, CA (United States). 15 Mar 1990. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-89ER60885. Order Number DE94012342. Source: OSTI; NTIS; GPO Dep.

We report new analyses to test competing models of the Daphnia/algal interaction. Our model is good at predicting equilibrium algal densities, and if our new insights can account for stability in this system across a wide range of natural environments, this may contribute to understanding predator-prey dynamics in general.

22611 (DOE/ER/61037–3) **Atmospheric gas: Annual report, August 1, 1992–July 31, 1993.** Schudlich, R.; Emerson, S. Washington Univ., Seattle, WA (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER61037. Order Number DE94007439. Source: OSTI; NTIS; GPO Dep.

This proposal requests support for a third year of funding to complete a modelling study of processes controlling the distribution and waters at an ocean location with detailed background measurements of biological physical properties. We determined concentrations of the gases O_2, Ar, N_2, and the stable isotope ratio ($^{18}O/^{16}O$) of molecular oxygen in surface waters at Station ALOHA in conjunction with the Global Ocean Flux Study (GOFS) Hawaiian Ocean Time-series project during the years 1989–90 and 1992–93, the latter currently being completed. Chemical tracers have been incorporated into an existing ocean mixed-layer model to simulate the physical processes controlling the distribution and seasonal cycle of dissolved gases in the upper ocean. The broad background of concurrent chemical, physical, and biological measurements at station ALOHA provides enough redundancy of "ground truth" to assess the model's accuracy. Biological oxygen production estimated from modeled chemical tracers agrees with estimates based on measurements of carbon fluxes into the deep ocean and nitrate fluxes into the upper ocean during 1989–90, verifying for the first time the utility of chemical tracers for determining biological fluxes in the ocean. The results suggest that in the euphoric zone the net biological O_2 production and CO_2 consumption is 4.5 moles $m^{-2}yr^{-1}$. We propose to continue this project an additional year to incorporate isotope data into the simulation and to analyze the 1992–93 data.

22612 (DOE/ER/61541–T1) **Measurement of DIC, Alkalinity and pH of the WOCE/HP cruises: Progress report.** Winn, C.D. Hawaii Univ., Honolulu, HI (United States). 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-93ER61541. Order Number DE94008499. Source: OSTI; NTIS; GPO Dep.

During the early part of 1993, we have developed the methodology and assembled the instrumentation necessary to make inorganic carbon measurements on the WOCE/HP cruises. We have developed a spectrophotometric system for the measurement of pH. We have also become familiar with the closed cell titration techniques for the measurement of total alkalinity, and have intercalibrated this procedure with the standard open cell techniques used in our laboratory to ensure analytical consistency. We have adopted the closed-cell approach for use on the WOCE lines, as opposed to our standard open-cell methodology in order to be consistent with the other laboratories participating in the WOCE/HP inorganic carbon survey. We have also received a Department of Energy SOMMA in May of this year and have become familiar with this rather complex instrument. This instrument was successfully used on our first WOCE leg in July and August on 1993.

22613 (DOE/EW/53023–T5-Exec.Summ.) **Hazardous materials in aquatic environments of the Mississippi River Basin: Annual technical report, December 30, 1992–December 29, 1993.** Tulane Univ., New Orleans, LA (United States). Center for Bioenvironmental Research; Xavier Univ. of Louisiana, New Orleans, LA (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-93EW53023. Order Number DE94010676. Source: OSTI; NTIS; INIS; GPO Dep.

Tulane and Xavier Universities have singled out the environment as a major strategic focus for research and training for now and by the year 2000. In December, 1992, the Tulane/Xavier CBR was awarded a five year grant to study pollution in the Mississippi River system. The "Hazardous Materials in Aquatic Environments of the Mississippi River Basin" project is a broad research and education program aimed at elucidating the nature and magnitude of toxic materials that contaminate aquatic environments of the Mississippi River Basin. Studies include defining the complex interactions that occur during the transport of contaminants, the actual and potential impact on ecological systems and health, and the mechanisms through which these impacts might be remediated. The Mississippi River Basin represents a model system for analyzing and solving contamination problems that are found in aquatic systems worldwide. These research and education projects are particularly relevant to the US Department of Energy's programs aimed at addressing aquatic pollution problems associated with DOE National Laboratories. First year funding supported seven collaborative cluster projects and twelve initiation projects. This report summarizes research results for period December 1992–December 1993.

22614 (DOE/EW/53023–T6) **Hazardous materials in Aquatic environments of the Mississippi River basin: Quarterly project status report, 1 January 1994–30 March 1994.** Abdelghani, A. Tulane Univ., New Orleans, LA (United States). [1994]. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-93EW53023. Order Number DE94013033. Source: OSTI; NTIS; GPO Dep.

Projects associated with this grant for studying hazardous materials in aquatic environments of the Mississippi River Basin are reviewed and goals, progress and research results are discussed. New, one-year initiation projects are described briefly.

22615 (ENEA-RT-AMB–92-27) **Humic and fulvic acids in marine sediments: Chemical analysis.** De Simone, R. (ENEA, Portici (Italy). Centro Ricerche Fotovoltaiche - Area Energia Ambiente e Salute). ENEA, Portici (Italy). Centro Ricerche Fotovoltaiche - Area Energia Ambiente e Salute. Nov 1993. 20p. (In Italian). (RT/AMB–92-27). Order Number DE94775307. Source: OSTI; NTIS (US Sales Only).

A functional approach to investigate humic substances in marine sediments is presented. Sedimentary humic compounds are isolated from core samples using consecutive hydroxide (free acids) and pyrophosphate (combined acids) extractions. Determination of the amount of humic and fulvic acids are made by UV absorbance (humic=420nm; fulvic=330nm).

22616 (ENEA-RT-AMB–92-28) **Variation of major and trace elements in some lakes at Terra Nova Bay (Antarctica): December 1990-February 1991.** Caprioli, R. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Falchi, G.; Gragnani, R.; Torcini, S. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. Nov 1993. 22p. (RT/AMB–92-28). Order Number DE94775295. Source: OSTI; NTIS (US Sales Only).

The chemical composition data on lake waters sampled in the area of Edmonson Point, Carezza, Inexpressible Island, Andersson Ridge and Tarn Flat are presented and discussed. The averages of total dissolved solids (TDS) of each lake range from 95 mg/l to 3765 mg/l. The chemical composition is characterized by high contents of Na and Cl. During the sampling period, the salinity showed constant or increasing values. The processes that condition this behaviour are examined and discussed. In general, the concentration of trace elements does not reveal any significant trend over time, and only the nickel content in lakes changes with respect to the increase in salinity.

22617 (ENEA-RT-AMB–93-07) **Local diffusion coefficient determination: Mediterranean Sea experiments.** Bacciola, D.

(Consiglio Nazionale delle Ricerche, S. Teresa (Italy). ISDGM-Stazione Oceanografica); Borghini, M.; Cannarsa, S. ENEA, La Spezia (Italy). Centro Ricerche Energia Ambiente Santa Teresa - Area Energia Ambiente e Salute. Oct 1993. 161p. (In Italian). (RT/AMB–93-07). Order Number DE94775261. Source: OSTI; NTIS (US Sales Only); INIS.

The Mediterranean is a semi/enclosed basin characterized by the presence of channels and straits influencing the circulation, temperature and salinity fields. The tides generally have amplitudes of the order of 10 cm and velocities of few cm/s. Conversely, the wind forced circulation is very strong and can assume velocity values of 1 m/s at the sea surface. The temperature and salinity fields have a high temporal and spatial variability, because of many mixing processes existing in the sea. For example, the waters coming from the Provencal basin meet those waters coming from the Tyrrhenian Sea in the eastern Ligurian Sea, creating meanders and eddies. Local runoff influences significantly the coastal circulation. This paper describes diffusion experiments carried out in this complex environment. The experimental apparatus for the detection of the fluorescine released at sea was composed by two Turner mod. 450 fluorometres. During the experiments, temperature and salinity vertical profiles were measured by using a CTD; meteorological data were acquired on a dinghy. The positioning was obtained by means of a Motorola system, having a precision of about 1 meter. The experiments were carried out under different stratification and wind conditions. From data analysis it was found that the horizontal diffusion coefficient does not depend on time or boundary conditions. The role of stratification is important with regard to vertical displacement of the dye. However, its role with regard to vertical diffusion cannot be assessed with the actual experimental apparatus.

22618 (ENEA-RT-AMB–93-18) **Radiological protection and environmental safety (tritium).** Cigna, A.A. (ENEA, Saluggia (Italy). Centro Ricerche Energia - Area Energia Ambiente e Salute); Risposi, L. ENEA, Saluggia (Italy). Centro Ricerche Energia - Area Energia Ambiente e Salute. Nov 1993. 26p. (RT/AMB–93-18). Order Number DE94775314. Source: OSTI; NTIS (US Sales Only).

The behaviour of tritium after its discharge into the environment in different conditions is described and the influence of some environmental parameters is also considered. Then its incorporation into biota is taken into account and a simple model for the description of the whole cycle of tritium and the dose evaluation to man is reported with reference to the Ispra (Italy) site as an example.

22619 (INIS-BR–3317) **Bioaccumulation and elimination of ^{60} Co and ^{137} Cs by Anomalocardia brasiliana (Gmelin, 1791) (Mollusca bivalvia). Remobilization of ^{60} Co, retained in marine sediment by microbial activity.** Mayr, L.M. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Biofisica. May 1984. 142p. (In Portuguese). Order Number DE94625928. Source: OSTI; NTIS (US Sales Only); INIS.

It was studied the capacity of a bi valve mollusc Anomalocardia brasiliana, which lives in the local bottom sediment, to remobilize ^{60} Co previously sorbed in the sediment. Laboratory experiments demonstrated that the transference of ^{60} Co from the sediment to the animal was insignificant (bioaccumulation factor (BF) of the order of 10^{-3}). At the same time, the capacity of microorganisms, present in the bottom sediment, to remobilize ^{60} Co was studied. The results showed that this via of transference was important, considering the much greater microorganism biomass in relation to the biomass of bentonic organisms, as a whole. For ^{137} Cs the determined BF from water to the animal was 2.2. and, as in the case of ^{60} Co, the soft tissues concentrated more ^{137} Cs than shell. Remaining viscera showed the highest BFs. In another series of experiments, the loss of ^{60} Co or ^{137} Cs, previously accumulated by A. brasiliana, was followed in aquaria with or without sediment and the respective biological half-lives were calculated. Soft tissues retained ^{60} Co longer (biological half-life = 117 days) than shells, whereas for ^{137} Cs the opposite was observed and shells showed a biological half life of 38.5 days. The low values of ^{60} Co and ^{137} Cs BF_S do not allow to classify A. brasiliana as good biological indicator for pollution by there radionuclides. However since A brasiliana is consumed by the local population and is commercialized to other areas, it was recommended that its contamination by ^{60} Co or ^{137} Cs should be monitored. (author).

22620 (INIS-BR–3324) **Use of ^{198} Au, with surface labelling, in the study of solid transport by bed load in large natural channels.** Nakahira, S. Sao Paulo Univ., SP (Brazil). Escola Politecnica. 1987. 227p. (In Portuguese). Order Number DE94625935. Source: OSTI; NTIS (US Sales Only); INIS.

The present study aims to present a method of measuring the bed load transport using a radioisotope technique in large natural channels. This study describes the basic principles of radioisotope application in this field, emphasizing the use of ^{198} Au for surface labelling of a natural sediment. Moreover, it presents the theoretical aspects, critical analysis, recommendations and comments on the methodology proposed. (author).

22621 (INIS-BR–3329) **Relations between the oxygen-18 values in natural water from hydro graphic basins.** Martinez, J.C. UNESP, Botucatu, SP (Brazil). Faculdade de Ciencias Agronomicas. Feb 1990. 135p. (In Portuguese). Order Number DE94625929. Source: OSTI; NTIS (US Sales Only); INIS.

After the observation of certain basic condition necessary to the application of research, the experiment was accomplished in two small watersheds, under agricultural utilization, with surfaces of 1,581 km^2 and 3,268 Km^2, drained by the Bufalos and Paraiso streams respectively. For four years (from February 1, 1984 to December 31, 1987) the values of the oxygen -18 content of the precipitation waters and those of the streams were analysed. The waters of the observation well, and those of the soil in their most varied depths, were analysed from december 4, 1986 to september 1, 1987. The oxygen - 18 obtained values were applied in there different models which estimate the water residence time in a watershed, and consequently other hydrology characteristics. (author).

22622 (INIS-mf–14216) **Modes of ocean variability in the tropical Pacific as derived from GEOSAT altimetry.** Report - Max-Planck-Institut fuer Meteorologie, v. 103. Zou Jiansheng (Hamburg Univ. (Germany). Inst. fuer Meereskunde); Latif, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Apr 1993. 36p. Order Number DE94774250. Source: OSTI; NTIS (US Sales Only); INIS.

Satellite-derived (GEOSAT) sea surface height anomalies for the period November 1986 to August 1989 were investigated in order to extract the dominant modes of climate variability in the tropical Pacific. Four modes are identified by applying the POP technique. The first mode has a time scale of about 3 months and can be identified with the first baroclinic equatorial Kelvin wave mode. The second mode has a time scale of about six months and describes the semi-annual cycle in tropical Pacific sea level. Equatorial wave propagation is also crucial for this mode. The third mode is the annual cycle which is dominated by Ekman dynamics. Wave propagation or reflection are found to be unimportant. The fourth mode is associated with the El Nino/Southern Oscillation (ENSO) phenomenon. The ENSO mode is found to be consistent with the 'delayed action oscillator' scenario. The results are substantiated by a companion analysis of the sea surface height variability simulated with an oceanic general circulation model (OGCM) forced by observed wind stresses for the period 1961 to 1989. The modal decomposition of the sea level variability is found to be similar to that derived from the GEOSAT data. The high consistency between the satellite and the model data indicates the high potential value of satellite altimetry for climate modeling and forecasting. (orig.)

22623 (INIS-mf–14217) **49th report of the Arbeitsgemeinschaft Rhein-Wasserwerke e.V.. Annual report 1992.** Arbeitsgemeinschaft Rhein-Wasserwerke e.V. (ARW), Koeln (Germany). 1992. 274p. (In German). Order Number DE94774160. Source: OSTI; NTIS (US Sales Only); INIS.

The annual report of the Arbeitsgemeinschaft Rhein-Wasserwerke (ARW) discusses the following subjects: (1) ARW report on water quality; (2) the problem of herbicides and pesticides; (3) Duesseldorf-Flehe Rhine river monitoring station - construction and performance; (4) observations concerning the aerobic degradation capacity of the river banks as a functional of the

seasonal temperature variations of the Rhine; (5) results of Rhine water analyses of GEW-Werke Koeln AG in 1992; (6) statistical methods of generating groundwater levels in ground water aquifers under the influence of outfall ditches. The appendix contains the analyses of the year 1992, the data acquired by GEW-Werke Koeln AG for 1992, the 1993 monitoring programme, and a survey of the organisational structure of the Arbeitsgemeinschaft Rhein-Wasserwerke e.V. (orig./BRR)

22624 (INIS-mf–14228) **Water quality report of Nordrhein-Westfalen 1991.** Kirchner, W. (comp.); Holbeck, I. (comp.); Vogt, K. (comp.). Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany). Oct 1992. 113p. (In German). Order Number DE94773973. Source: OSTI; NTIS (US Sales Only); INIS.

The water quality in Nordrhein-Westfalen improved in 1991. The report, compiled in cooperation with the 8 state Authorities for Water and Waste Management and the Land Authority for the Fishing Industry, shows that water purification measures are successful, and that the technical standard of surface water monitoring in Nordrhein-Westfalen is remarkably high. (orig.)

22625 (INIS-mf–14247) **Water quality data of the Elbe from Schnackenburg to the Sea: 1991 data.** Arbeitsgemeinschaft fuer die Reinhaltung der Elbe der Laender Hamburg, Niedersachsen und Schleswig-Holstein, Hamburg (Germany); Wasserguetestelle Elbe, Hamburg (Germany). Aug 1992. 196p. (In German). Order Number DE94774263. Source: OSTI; NTIS (US Sales Only); INIS.

The working pool for pollution control of the Elbe of the states Hamburg, Lower Saxony and Schleswig-Holstein (ARGE ELBE) published in its annual reports 'water quality data of the Elbe' results of water quality analyses carried out within the scope of the joint ARGE ELBE measuring program in the section of the Elbe from Schnackenburg to the North Sea including the lower reaches of tributaries of the Elbe. The documentation of measuring data in numerical tables is aligned with the needs of specialized offices of the states and the government as well as of research and university institutes. (orig.)

22626 (INIS-mf–14254) **Numerical tables of the physical-chemical tests 1991.** Arbeitsgemeinschaft der Laender zur Reinhaltung der Weser, Bremen (Germany). 1993. 171p. (In German). Order Number DE94773907. Source: OSTI; NTIS (US Sales Only); INIS.

The Working Party for the Water Purity of the Weser River has been monitoring samples from particular parts of the Weser, Fulda and Werra rivers since 1 January '79 as a part of the Weser monitoring programme, covering 16 areas. In the following numerical tables, the 1991 data is given from the measurements with consistent parameters, the fortnightly separate tests, the 2- and 8-weekly mixed tests, as well as the 2 trials carried out on selected halogenousus hydrocarbon, annual sediment tests on heavy metal and the seston investigations. For selected measuring factors, longer-term data has also been given, along with the main results and graphical illustrations. The annual variations are thereby illustrated and can be compared. (UWA)

22627 (INIS-mf–14255) **Heavy metal burden of the Pinnau river.** Berichte des Landesamtes fuer Wasserhaushalt und Kuesten Schleswig-Holstein. Reihe D, v. 12. Ministerium fuer Natur, Umwelt und Landesentwicklung des Landes Schleswig-Holstein, Kiel (Germany); Landesamt fuer Wasserhaushalt und Kuesten Schleswig-Holstein, Kiel (Germany). 1993. 59p. (In German). Order Number DE94773974. Source: OSTI; NTIS (US Sales Only); INIS.

The water phase and sediment of the Pinnau river were investigated for their heavy-metal pollution. Tests for the elements chromium, mercury, nickel, arsenic, lead, copper, cadmium, zinc and iron were carried through with sediment samples in 1984 and 1989 and with water samples in 1987 and 1989. Whereas no significant changes in the levels of these metals were found in the water phase during the two-year period of invetigation, slightly reduced levels of zinc, cadmium and mercury were established in the sediment in 1989 as compared to 1984. (orig.)

22628 (LA-UR–94-1216) **Characterization of uranium and plutonium in surface-waters and sediments collected at the Rocky Flats Facility.** Efurd, D.W.; Rokop, D.J.; Aguilar, R.D.; Roensch, F.R.; Perrin, R.E.; Banar, J.C. Los Alamos National Lab., NM (United States). [1994]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940301–31: 207. spring national meeting of the American Chemical Society (ACS), San Diego, CA (United States), 13-18 Mar 1994). Order Number DE94011656. Source: OSTI; NTIS; INIS; GPO Dep.

This study was initiated to characterize actinides in environmental samples collected at the Rocky Flats Plant (RFP). Thermal Ionization Mass Spectrometry (TIMS) measurement techniques were used to measure the plutonium and uranium content of water and sediment samples collected from the ponds used to control surface-waters on-site at RFP. TIMS was also used to separate the uranium into anthropogenic and naturally occurring components. The results of these studies are presented.

22629 (LA-UR–94-1720) **Characterization of uranium in surface-waters collected at the Rocky Flats Facility.** Efurd, D.W.; Rokop, D.J.; Aguilar, R.D.; Roensch, F.R.; Perrin, R.E.; Banar, J.C. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940556–1: Alfred O. Nier symposium on inorganic mass spectrometry, Durango, CO (United States), 10-12 May 1994). Order Number DE94013120. Source: OSTI; NTIS; INIS; GPO Dep.

The Rocky Flats Plant (RFP) is a Department of Energy (DOE) facility where plutonium and uranium components were manufactured for nuclear weapons. During plant operations radioactivity was inadvertently released into the environment. This study was initiated to characterize the uranium present in surface-waters at RFP. Three drainage basins and natural ephemeral streams transverse RFP. The Woman Creek drainage basin traverses and drains the southern portion of the site. The Rock Creek drainage basin drains the northwestern portion of the plant complex. The Walnut Creek drainage basin traverses the western, northern, and northeastern portions of the RFP site. Dams, detention ponds, diversion structures, and ditches have been constructed at RFP to control the release of plant discharges and surface (storm water) runoff. The ponds located downstream of the plant complex on North Walnut Creek are designated A-1 through A-4. Ponds on South Walnut Creek are designated B-1 through B-5. The ponds in the Woman Creek drainage basin are designated C-1 and C-2. Water samples were collected from each pond and the uranium was characterized by TIMS measurement techniques.

22630 (ORNL/FTR–4919) **To attend a UN workshop in England as an expert on biological markers and prepare a scoping document on indicators of Marine Ecosystem Health: Foreign trip report, February 26–March 4, 1994.** Shugart, L.R. Oak Ridge National Lab., TN (United States). 10 Mar 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94009142. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In answer to the growing need to assess biological responses to anthropogenically induced changes and to define environmental crtieria that can be used to indicate the health of marine ecosystems throughout the world, the Goup of Experts on the Scientific Aspects of Marine Pollution (GESAMP) established Working Group 33 (WG-33) on Indicators of Marine Ecosystem Health. The UN Environmental Program (UNEP) convened the first meeting of WG-33 in the fall of 1992 in Geneva, and a preliminary report was forwarded to GESAMP. In light of the substantial progress made by WG-33, another meeting was recommended for London from February 27 to March 4, 1994, to finalize the report.

22631 (ORNL/TM–11544) **Fourth report on the Oak Ridge National Laboratory Biological Monitoring and Abatement Program for White Oak Creek Watershed and the Clinch River.** Loar, J.M. (ed.). Oak Ridge National Lab., TN (United States). Apr 1994. 277p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012499. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication No. 4070.

In response to a condition of the National Pollutant Discharge Elimination System (NPDES) permit issued to Oak Ridge National Laboratory (ORNL) on April 1, 1986, a Biological Monitoring and

Abatement Program (BMAP) was developed for White Oak Creek (WOC) and selected tributaries. BMAP currently consists of six major tasks that address both radiological and nonradiological contaminants in the aquatic and terrestrial environs on-site and the aquatic environs off-site. These tasks are (1) toxicity monitoring, (2) bioaccumulation monitoring of nonradiological contaminants in aquatic biota, (3) biological indicator studies, (4) instream ecological monitoring, (5) assessment of contaminants in the terrestrial environment, and (6) radioecology of WOC and White Oak Lake. The ecological characterization of the WOC watershed will provide baseline data that can be used to document the ecological effects of the water pollution control program and the remedial action program. The long-term nature of BMAP ensures that the effectiveness of remedial measures will be properly evaluated.

22632 (PNL–9799) **Sediment quality criteria: A review with recommendations for developing criteria for the Hanford Site.** Driver, C.J. Pacific Northwest Lab., Richland, WA (United States). May 1994. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012777. Source: OSTI; NTIS; GPO Dep.

Criteria for determining the quality of liver sediment are necessary to ensure that concentrations of contaminants in aquatic systems are within acceptable limits for the protection of aquatic and human life. Such criteria should facilitate decision-making about remediation, handling, and disposal of contaminants. Several approaches to the development of sediment quality criteria (SQC) have been described and include both descriptive and numerical methods. However, no single method measures all impacts at all times to all organisms (U.S. EPA 1992b). The U.S. EPA's interest is primarily in establishing chemically based, numerical SQC that are applicable nation-wide (Shea 1988). Of the approaches proposed for SQC development, only three are being considered for numerical SQC on a national level. These approaches include an Equilibrium Partitioning Approach, a site-specific method using bioassays (the Apparent Effects Threshold Approach), and an approach similar to EPA's water quality criteria (Pavlou and Weston 1984). Although national (or even regional) criteria address a number of political, litigative, and engineering needs, some researchers feel that protection of benthic communities require site-specific, biologically based criteria (Baudo et al. 1990). This is particularly true for areas where complex mixtures of contaminants are present in sediments. Other scientifically valid and accepted procedures for freshwater SQC include a background concentration approach, methods using field or spiked bioassays, a screening level concentration approach, the Apparent Effects Threshold Approach, the Sediment Quality Triad, the International Joint Commission Sediment Assessment Strategy, and the National Status and Trends Program Approach. The various sediment assessment approaches are evaluated for application to the Hanford Reach and recommendations for Hanford Site sediment quality criteria are discussed.

22633 (UBA-FB–92-127) **Organica micropollutants in the aquatic environment: identification of cationic surfactants.** Levsen, K. Umweltbundesamt, Berlin (Germany); Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany). Aug 1992. 104p. (In German). Sponsored by Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Contract UFOPLAN 10205144. Order Number DE94774257. Source: OSTI; NTIS (US Sales Only); INIS.

The data (concentrations, pollution loads) measured for the 560 km flowing stretch of the river Elbe on the territory of the former GDR were compiled and evaluated according to primary statistical aspects. The longitudinal section was prepared for major variables with regard to the flow for Q50% and Q5%. The distribution of concentration in various measuring points was shown by means of box plots. Interdependencies between concentration and flow as well as water temperature were investigated and used for assessing diffuse matter input. In addition to determining the saprobic index, the biological control of water pollution comprised the assessment of the macrozoobenthos in the area of sewage discharge, chlorophyll measurements, an inventory of the fish population, analysis of pollutant accumulation in fish and in zoobenthos as well as virus detection. The water quality of the river Elbe was evaluated in compliance with the binding E.C. guidelines and national regulations/recommendations revealing an extreme pollution level which impairs or excludes various utilizations of the Elbe water. (orig.). 73 refs., 11 tabs., 48 figs.

22634 (UCRL-ID–116541) **Transuranic radionuclides dispersed into the aquatic environment, a bibliography.** Noshkin, V.E. (and others); Stoker, A.C.; Wong, Kai M. Lawrence Livermore National Lab., CA (United States). Apr 1994. 155p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012409. Source: OSTI; NTIS; GPO Dep.

The purpose of this project was to compile a bibliography of references containing environmental transuranic radionuclide data. Our intent was to identify those parameters affecting transuranic radionuclide transport that may be generic and those that may be dependent on chemical form and/or environmental conditions (i.e., site specific) in terrestrial, aquatic and atmospheric environments An understanding of the unique characteristics and similarities between source terms and environmental conditions relative to transuranic radionuclide transport and cycling will provide the ability to assess and predict the long term impact on man and the environment. An additional goal of our literature review, was to extract the ranges of environmental transuranic radionuclide data from the identified references for inclusion in a data base. Related to source term, these ranges of data can be used to calculate the dose to man from the radionuclides, and to perform uncertainty analyses on these dose assessments. On the basis of our reviews, we have arbitrarily outlined five general source terms. These are fallout, fuel cycle waste, accidents, disposal sites and resuspension. Resuspension of the transuranic radionuclides is a unique source term, in that the radionuclides can originate from any of the other source terms. If these transuranic radionuclides become resuspended into the air, they then become important as a source of inhaled radionuclides.

22635 (UCRL-JC–115860) **The influence of tributaries on nocturnal valley flows.** Leone, J.M. Jr.; Walker, H. Lawrence Livermore National Lab., CA (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940769–3: 6. conference on mesoscale processes, Portland, OR (United States), 18-22 Jul 1994). Order Number DE94011613. Source: OSTI; NTIS; GPO Dep.

While much is known about nocturnal drainage flow down a mountain valley, the factors that determine the structure of the valley flow are not completely understood. For example, there are a number of questions regarding the influence of tributaries on the valley flow. Does the presence of tributaries increase or decrease the mass flux out of the valley; does their presence alter the mass flux along the valley; how is the drainage jet structure modified by the presence of tributaries; or, is their presence insignificant? In this study, we investigate these questions via numerical experiments.

22636 (UCRL-JC–116517) **Simple ocean carbon cycle models.** Caldeira, K. (Lawrence Livermore National Lab., CA (United States)); Hoffert, M.I.; Siegenthaler, U. Lawrence Livermore National Lab., CA (United States). Feb 1994. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9307181–1: Snowmass Global Change Institute conference on the global carbon cycle, Snowmass, CO (United States), 19-30 Jul 1993). Order Number DE94011745. Source: OSTI; NTIS; GPO Dep.

Simple ocean carbon cycle models can be used to calculate the rate at which the oceans are likely to absorb CO_2 from the atmosphere. For problems involving steady-state ocean circulation, well calibrated ocean models produce results that are very similar to results obtained using general circulation models. Hence, simple ocean carbon cycle models may be appropriate for use in studies in which the time or expense of running large scale general circulation models would be prohibitive. Simple ocean models have the advantage of being based on a small number of explicit assumptions. The simplicity of these ocean models facilitates the understanding of model results.

22637 (WSRC-MS–94-0192) **Inter-replicate variance and statistical power of electrofishing data from low gradient streams.** Paller, M.H. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012448. Source: OSTI; NTIS; GPO Dep.

Electrofishing data from streams on the coastal plain of South Carolina were used to assess the relationship between inter-replicate variance and the mean for catch per unit effort expressed as number of fish per 100 m^2 of stream surface area. Variance and mean were strongly and positively related. This relationship was unaffected by type and quantity of instream structure and was consistent among schooling and nonschooling species. Computations of statistical power indicated that large numbers of samples (>25) were required to detect small (<20%) differences among means and that the required number of samples was greater when catch per unit effort was low. Inter-replicate variance increased as the reach length of individual replicates decreased, with the greatest increases occurring at replicate reach lengths under 60 m. Inter-replicate variance can be decreased by increasing sampling effort (i.e., multiple passes) and by employing replicate reaches that are long. However, the most cost-effective approach may be to employ single passes and replicates of moderate size.

22638 (WSRC-MS–94-0251) **Numerical simulation of nocturnal drainage flows in an idealized valley-tributary system.** O'Steen, L.B. Westinghouse Savannah River Co., Aiken, SC (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-940769–2: 6. conference on mesoscale processes, Portland, OR (United States), 18-22 Jul 1994). Order Number DE94011684. Source: OSTI; NTIS; GPO Dep.

During 1984 and 1988 a substantial amount of meteorological field data was collected in the Brush Creek valley area of western Colorado as a part of the Atmospheric Science in Complex Terrain (ASCOT) program. This field experiment was designed to investigate the characteristics of nocturnal drainage flows in valleys as well as valley tributaries and sidewalls. The data collected during the Brush Creek experiment has been used to study a variety of nocturnal flow phenomena including: velocity and thermal structure of slope and valley flows; mass, momentum and energy balances in valleys and tributaries; tracer transport and diffusion in valley drainage flows. In support of the Brush Creek experiments, several mesoscale modeling studies have been performed. The numerical studies dealt with various aspects of along-valley nocturnal drainage flow. However, a good deal of effort was expended studying tributary flows and their interaction with the along-valley wind system. These investigations generated considerable debate over the contribution of tributaries to the valley mass flux and the source of observed velocity oscillations in valley-tributary systems. In this study, results from simulations of nocturnal drainage in an idealized valley-tributary-plain system are presented.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 21715

22639 (ANL/BIM/PP–73690) **Genomic definition of species.** Crkvenjakov, R.; Drmanac, R. Argonne National Lab., IL (United States). Jul 1991. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013315. Source: OSTI; NTIS; GPO Dep.

The subject of this paper is the definition of species based on the assumption that genome is the fundamental level for the origin and maintenance of biological diversity. For this view to be logically consistent it is necessary to assume the existence and operation of the new law which we call genome law. For this reason the genome law is included in the explanation of species phenomenon presented here even if its precise formulation and elaboration are left for the future. The intellectual underpinnings of this definition can be traced to Goldschmidt. We wish to explore some philosophical aspects of the definition of species in terms of the genome. The point of proposing the definition on these grounds is that any real advance in evolutionary theory has to be correct in both its philosophy and its science.

22640 (ANL/BIM/PP–73690-Rev.1) **Genomic definition of species: Revision 1.** Crkvenjakov, R.; Dramanac, R. Argonne National Lab., IL (United States). Jun 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013313. Source: OSTI; NTIS; GPO Dep.

A genome is the sum total of the DNA sequences in the cells of an individual organism. The common usage that species possess genomes comes naturally to biochemists, who have shown that all protein and nucleic acid molecules are at the same time species and individual-specific, with minor individual variations being superimposed on a consensus sequence that is constant for a species. By extension, this property is attributed to the common features of DNA in the chromosomes of members of a given species and is called (species) genome. The definition of species based on chromosomes, genes, or genome common to its member organisms has been implied or mentioned in passing numerous times. Some population biologists think that members of species have similar "homeostatic genotypes," which are to a degree resistant to mutation or environmental change in the production of a basic phenotype.

22641 (ANL/BIM/PP–73690-Rev.2) **Genomic definition of species: Revision 2.** Crkvenjakov, R.; Drmanac, R. Argonne National Lab., IL (United States). Mar 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94013312. Source: OSTI; NTIS; GPO Dep.

A genome is the sum total of the DNA sequences in the cells of an individual organism. The common usage that species possess genomes comes naturally to biochemists, who have shown that all protein and nucleic acid molecules are at the same time species-and individual-specific, with minor individual variations being superimposed on a consensus sequence that is constant for a species. By extension, this property is attributed to the common features of DNA in the chromosomes of members of a given species and is called species genome. Our proposal for the definition of a biological species is as follows: A species comprises a group of actual and potential biological organisms built according to a unique genome program that is recorded, and at least in part expressed, in the structures of their genomic nucleic acid molecule(s), having intragroup sequence differences which can be fully interconverted in the process of organismal reproduction.

5501 Behavioral Biology

Refer also to citation(s) 21180, 21182, 22670

22642 (DOE/BP/35245–5) **Assessment of smolt condition for travel time analysis: Annual report, 1991–1992.** Maule, A.G. (Columbia River Research Lab., Cook, WA (United States)); Beeman, J.W.; Schrock, R.M.; Harner, P.V. USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife. May 1994. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI79-87BP35245. Order Number DE94013094. Source: OSTI; NTIS; GPO Dep.

Regression techniques were used to determine the effects of several biotic and abiotic variables on the migration rates of juvenile spring chinook salmon and steelhead in the Columbia and Snake rivers. Comparisons of the effects of river flow and smoltification, assessed using gill Na^+-K^+ ATPase activity, were of primary interest. Day of the year, water temperature, change in flow, condition factor, and fork length were also considered as independent variables. Groups of fish were sampled to assess smoltification 2-3 times per week during the spring outmigrations during 1989-1992. These groups were assumed to be representative of other fish which were PIT-tagged and released as a part of the Smolt Monitoring Program in the Columbia Basin. River flow, gill ATPase activity, condition factor, water temperature, and change in flow were significant variables in regressions predicting the time for juvenile spring chinook salmon to travel between specific points (travel time), whereas river flow was the only significant contributor to models

describing travel times of steelhead. Predicted travel times of wild steelhead were shorter than those of hatchery steelhead. River flow was the only variable common to all regression equations. Based on the characteristic, changes in river flow would be the most logical means to decrease travel times of both juvenile spring chinook salmon and steelhead in the Columbia and Snake rivers.

22643 (DOE/BP/38906–3) **Fish Passage Center. Annual Report 1993.** Fish Passage Center, Portland, OR (United States). Apr 1994. 249p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC79-88BP38906. Order Number DE94013081. Source: OSTI; NTIS; GPO Dep.

The 1993 downstream migration of juvenile salmon experienced much better outmigration conditions than in recent years. Higher flows occurred in the spring, due to above-average spring precipitation and larger runoff volumes. Higher flows in the summer period resulted from implementation of Opinion flow targets. All indicators, passage indices, proportion of marks reaptured, and migration duration and pattern, indicate that fall chinook juveniles in particular benefitted from the passage conditions provided in 1993. Wild and hatchery spring chinook and steelhead responded to the conditions provided with faster travel times and a higher proportion reaching sample sites, when compared to past years, indicating improved survival. High uncontrolled runoff resulted in higher spill levels, benefitting fish passage, but also minor incidence of gas bubble trauma. Large scale problems were not observed. Very low returns of chinook jacks and one salt steelhead reflected the dismal outmigration conditions provided under the 1992 mitigation measures.

5502 Biochemistry

Refer also to citation(s) 20668, 21147, 21148, 21152, 21154, 22081, 22663, 22665, 22671

22644 (CONF-9209464–Summ.) **Genome Sequencing and Analysis Conference IV.** Baylor Coll. of Medicine, Houston, TX (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-92ER61511. From 4. genome seqencing and analysis conference; Hilton Head, SC (United States); 26-30 Sep 1992. Order Number DE94012166. Source: OSTI; NTIS; GPO Dep.

J. Craig Venter and C. Thomas Caskey co-chaired Genome Sequencing and Analysis Conference IV held at Hilton Head, South Carolina from September 26–30, 1992. Venter opened the conference by noting that approximately 400 researchers from 16 nations were present four times as many participants as at Genome Sequencing Conference I in 1989. Venter also introduced the Data Fair, a new component of the conference allowing exchange and on-site computer analysis of unpublished sequence data.

22645 (DOE/ER/13533–9) **Photoassembly of the photosystem II manganese cluster.** Blubaugh, D.J. (Kentucky Univ., Lexington, KY (United States)); Cheniae, G.M. Kentucky Univ., Lexington, KY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER13533. (CONF-9108256–2: 9. international conference on photosynthesis, Nagoya (Japan), Aug 1991). Order Number DE94013487. Source: OSTI; NTIS; GPO Dep.

Assembly of the photosynthetic water-oxidizing complex (WOC) is believed to involve the sequential oxidation and ligation of individual Mn atoms in a process called photoactivation. The kinetics with which photoactivation occurs has been interpreted to indicate a series mechanism, in which the product of the reaction of Mn^{2+} with the first PSII charge separation is unstable until processed by a second PSII charge separation. Because the decay of the unstable intermediate is accelerated in the presence of added reductants of Mn^{3+}, it has been hypothesized that the unstable intermediate is Mn^{3+} ligated with high affinity and stabilized by ligands supplied by WOC polypeptides. According to this hypothesis, photooxidation of a second Mn^{2+} to Mn^{3+}, followed by ligation of two more Mn^{2+} ions, results in formation of a stable Mn(II)2-Mn(III)2 complex. Several authors have reported a ≤ 1 μM K_m value for a Mn^{2+} (or Mn^{3+}) binding site in PSII. In most of these determinations, H_2O_2 was present. In another case, the K_m was determined from the inhibition by Mn^{2+} of diphenylcarbazide (DPC) photooxidation. On the other hand, the K_m for Mn^{2+} oxidation by Y_{Z+} in the absence of any other additions, is ~10 μM. We have postulated that this 10 μM value is the K_m for Mn^{2+} photooxidation by Y_{Z+} in the second photoact of the photoactivation mechanism, which occurs with low quantum efficiency. According to this view, the $Mn^{\leq 3+}$ ligated near Y_Z with high efficiency on the first photoact is responsible for the inhibition of DPC photooxidation in the presence of Mn^{2+} and for the low quantum efficiency of steady-state Mn^{2+} photooxidation Here, we provide evidence that this is the case.

22646 (DOE/ER/13900–3) **Structure and expression of nuclear genes encoding rubisco activase: Final technical report.** Zielinski, R.E. Illinois Univ., Urbana, IL (United States). [1994]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13900. Order Number DE94012790. Source: OSTI; NTIS; GPO Dep.

Rubisco activase (Rca) is a soluble chloroplast protein that catalyzes the activation of rubisco, the enzyme that initiates the photosynthetic carbon reduction cycle, to catalytic competency. Rca in barley consists of three polypeptides, one of 46- and two of 42-kDa, but the quaternary structure of the protein is not known. The authors have isolated and completely sequenced 8.8 kb of barley genomic DNA containing two, tandemly oriented activase genes (RcaA and RcaB) and three different cDNAs encoding the 42- and 46-kDa Rca polypeptide isoforms. Genomic Southern blot assays indicate that these sequences represent the entire Rca gene family in barley. Pre-mRNAs transcribed from the RcaA gene are alternatively spliced to give mRNAs encoding both 46- (RcaA1) and 42-kDa (RcaA2) Rca isoforms. The RcaB gene encodes a single polypeptide of 42 kDa. Primer extension and northern blot assays indicate that RcaB mRNA is expressed at a level that is 10- to 100-fold lower than RcaA mRNA. Analyses at the mRNA and protein level showed that Rca gene expression is coordinated by that of the rubisco subunits during barley leaf development.

22647 (DOE/ER/14031–4) **The chlorophyll-binding protein CP47 in photosystem II: Progress report.** Vermaas, W.F.J. Arizona State Univ., Tempe, AZ (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14031. Order Number DE94012837. Source: OSTI; NTIS; GPO Dep.

The CP47 protein is encoded by the psbB gene, binds 10-20 chlorophyll and has an apparent molecular weight of about 47 kDa. Specific mutations can be introduced into this protein using the transformable, (photo)heterotrophic cyanobacterium Synechocystis sp. PCC 6803. This cyanobacterium takes up foreign DNA spontaneously, and can survive in the absence of PS II activity to take out the wild-type psbB gene and subsequently replace it by a construct containing the desired mutation(s) in psbB. The PS I-less Synechocystis system we are now utilizing for studies of His mutations in the CP47 protein is a very useful strain for detailed studies of pigment-protein interactions and of the effects of limited pheophytinization in the antenna on light-harvesting efficiency. This is providing new information on parameters influencing energy transfer efficiency in photosynthetic systems. Moreover, studies regarding the hydrophilic regions of the CP47 protein are contributing to an understanding of the role of this protein in optimizing water-splitting activity.

22648 (DOE/ER/20024–2) **[Signal transduction in plant development: Chemical and biochemical approaches to receptor identification]: Progress report, [May 15, 1993–May 14, 1994].** Chicago Univ., IL (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20024. Order Number DE94012350. Source: OSTI; NTIS; GPO Dep.

Progress is reported on studies concerning NAD(P)H-2,6-DMBQ oxidoreductase of Striga asiatica aimed at elucidating basic biochemical parameters of Striga. Reported studies include characterization of the enzyme, development of Striga molecular genetics, and development of a redox model for germination control.

22649 (DOE/ER/20033–2) **[Regulation of alternative CO_2 fixation pathways in prokaryotic and eukaryotic photosynthetic organisms]: Progress report, June 15, 1991–June 14, 1993.** Tabita, R. Ohio State Univ., Columbus, OH (United States).

[1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20033. Order Number DE94013180. Source: OSTI; NTIS; GPO Dep.

The goal of this project to determine how photosynthetic microorganisms regulate the assimilation of CO_2 via pathways alternative to the usual Calvin-Benson-Bassham reductive pentose phosphate scheme, particularly in the molecular basis for switches in CO_2 metabolic paths. We have identified proteins on one-dimensional and two-dimensional SDS gels that appear differentially expressed in R. sphaeroides strain 16PHC which may be due to a mutation or change in some locus that controls the expression of several genes and their products. Similar observations were made relative to R. rubrum I-19 and the wild-type, namely that additional protein bands were observed in extracts of I-19 compared to the wild-type when both were grown photoheterotrophically with malate as electron donor and CO_2 as the obligatory electron acceptor. The results of Tn5 mutagenesis of R. sphaeroides 16PHC resulted in the isolation of several strains that effectively changed back to the 16 phenotype; i.e., no malate-dependent phototrophic growth with CO_2 as electron acceptor. We have found that both wild-type R. sphaeroides and R. rubrum, and the respective RubisCO negative mutant strains, are all capable of photolithoautotrophic growth using reduced sulfur compounds as electron donors and CO_2 as the sole carbon source and electron acceptor. The fact that the RubisCO negative are capable of photoautotrophic growth is an exciting development for us because it proves that alternative or nonCalvin CO_2 fixation pathways are extremely important to the overall carbon metabolism of these organisms. Moreover, wild-type strains turn off the synthesis of RubisCO under these cultural conditions. Thus, there appears to be separate autotrophic CO_2 fixation pathways in these organisms, and a major emphasis has been placed to identify how these bacteria can grow autotrophically and fix CO_2 in the absence of RubisCO.

22650 (DOE/ER/20063–1) **Regulation of extracellular polygalacturonase production in Pseudomonas solanacearum: Progress report, [May 1, 1992–April 30, 1994].** Allen, C. Wisconsin Univ., Madison, WI (United States). Dept. of Plant Pathology. [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER20063. Order Number DE94013694. Source: OSTI; NTIS; GPO Dep.

Pseudomonas solanacearum is an economically important plant pathogen that causes bacterial wilt disease of diverse crops. The bacterium produces at least three isozymes of polygalacturonase, which degrade plant cell walls and contribute substantially to bacterial wilt disease development. The central objective of this research project is to determine how expression of these enzymes is regulated. To this end, we isolated a positive trans-acting regulator of polygalacturonase production (pehR). We have focused on further characterization of the pehR mutant pheonotype, and studies of pehR expression. Preliminary results suggest pehR also regulates bacterial motility. An investigation of two unusual tyrosine phosphoproteins in P. solanacearum is also described.

22651 (DOE/ER/61136–3) **An improved method for producing radiation hybrids applied to human chromosome 19: Technical progress report, 1 March 1993–28 February 1994.** Jackson, C.L.; Mark, H.F.L. Rhode Island Hospital, Providence, RI (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61136. Order Number DE94011572. Source: OSTI; NTIS; GPO Dep.

Markers for which hybrids have been characterized have doubled from approximately 25 to 50 markers. Almost all new markers are microsatellite dinucleotide repeat markers. This will allow correlation of fragments of chromosome 19 in the hybrids with the genetic map. In situ hybridization is certainly one of the most direct methods of gene mapping in general and the most direct method to visualize the number of chromosome fragments in a hybrid. We have utilized fluorescent in situ hybridization (FISH) to determine the number of human fragments contained in the radiation hybrid cell lines.

22652 (DOE/ER/61394–1) **The lawful uses of knowledge from the Human Genome Project.** Grad, F.P. Columbia Univ., New York, NY (United States). 15 Apr 1994. 400p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61394. Order Number DE94012800. Source: OSTI; NTIS; GPO Dep.

Part I of this study deals with the right to know or not to know personal genetic information, and examines available legal protections of the right of privacy and the adverse effect of the disclosure of genetic information both on employment and insurance interests and on self esteem and protection of personal integrity. The study examines the rationale for the legal protection of privacy as the protection of a public interest. It examines the very limited protections currently available for privacy interests, including genetic privacy interests, and concludes that there is a need for broader, more far-reaching legal protections. The second part of the study is based on the assumption that as major a project as the Human Genome Project, spending billions of dollars on science which is health related, will indeed be applied for preventive and therapeutic public health purposes, as it has been in the past. It also addresses the recurring fear that public health initiatives in the genetic area must evolve a new eugenic agenda, that we must not repeat the miserable discriminatory experiences of the past.

22653 (UCRL-CR–112589) **Microfabricated DNA analysis system: Semi-annual report, August 1993–January 1994.** Northrup, M.A. Lawrence Livermore National Lab., CA (United States). Jan 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94009908. Source: OSTI; NTIS; GPO Dep.

We are miniaturizing instrumentation for the polymerase chain reaction (PCR) – a bioanalytical technique that amplifies target sections of DNA through thermal cycling. This report focuses on delineating reaction chamber, design parameters through computer modeling and infrared imaging. We have also continued microchamber-based PCR experiments and have successfully amplified three different targets from two different biological sources. Specifically, we have amplified DNA from β-globin (a subunit of hemoglobin), and two different-sized targets from the Human Immunodeficiency Virus (HIV). These experiments were performed in newly-designed chambers. Reaction chambers are also being designed with detection in mind, specifically for the detection of fluorescent DNA labels. Finally, some new developments in PCR technology are described as they represent potential biological diagnostics to be evaluated in microfabricated DNA analysis systems.

5504 Genetics

Refer also to citation(s) 22643, 22650, 22651, 22652

22654 (DOE/ER/61139–5) **Chromosome region-specific libraries for human genome analysis: Final progress report, 1 March 1991–28 February 1994.** Kao, F.T. Eleanor Roosevelt Inst., Denver, CO (United States). Apr 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61139. Order Number DE94012789. Source: OSTI; NTIS; GPO Dep.

The objectives of this grant proposal include (1) development of a chromosome microdissection and PCR-mediated microcloning technology, (2) application of this microtechnology to the construction of region-specific libraries for human genome analysis. During this grant period, the authors have successfully developed this microtechnology and have applied it to the construction of microdissection libraries for the following chromosome regions: a whole chromosome 21 (21E), 2 region-specific libraries for the long arm of chromosome 2, 2q35-q37 (2Q1) and 2q33-q35 (2Q2), and 4 region-specific libraries for the entire short arm of chromosome 2, 2p23-p25 (2P1), 2p21-p23 (2P2), 2p14-p16 (wP3) and 2p11-p13 (2P4). In addition, 20–40 unique sequence microclones have been isolated and characterized for genomic studies. These region-specific libraries and the single-copy microclones from the library have been used as valuable resources for (1) isolating microsatellite probes in linkage analysis to further refine the disease locus; (2) isolating corresponding clones with large inserts, e.g. YAC, BAC, P1, cosmid and phage, to facilitate construction of contigs for high resolution physical mapping; and (3) isolating region-specific cDNA clones for use as candidate genes. These libraries are being

deposited in the American Type Culture Collection (ATCC) for general distribution.

22655 (DOE/ER/61405–1) **X chromosome workshop: Final progress report.** Washington Univ., Seattle, WA (United States). Apr 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61405. (CONF-9204290–Summ.: 3. X chromosome workshop, Amalfi (Italy), 4-5 Apr 1992). Order Number DE94012798. Source: OSTI; NTIS; GPO Dep.

A brief overview is provided of the Third X Chromosome Workshop held April 3 and 4, 1992 in Amalfi, Italy.

5505 Metabolism

Refer also to citation(s) 21147

5506 Medicine

Refer also to citation(s) 21238, 22106

22656 (BNL–60383) **A 1200 element detector system for synchrotron-based coronary angiography.** Thompson, A.C. (Lawrence Berkeley Lab., CA (United States)); Lavender, W.M.; Rubenstein, E.; Giacomini, J.C.; Rosso, V.; Schulze, C.; Chapman, D.; Thomlinson, W. Brookhaven National Lab., Upton, NY (United States). 23 Aug 1993. 16p. Sponsored by USDOE, Washington, DC (United States);Department of Health and Human Services, Washington, DC (United States). DOE Contract AC02-76CH00016. Grant 1-R01-HL-39253-01. (CONF-930824–37: Synchrotron radiation instrumentation, Gaithersburg, MD (United States), 23-26 Aug 1993). Order Number DE94013540. Source: OSTI; NTIS; GPO Dep.

A 1200 channel Si(Li) detector system has been developed for transvenous coronary angiography experiments using synchrotron radiation. It is part of the synchrotron medical imaging facility at the National Synchrotron Light Source. The detector is made from a single crystal of lithium-drifted silicon with an active area 150 mm long x 11 mm high x 5 mm thick. The elements are arranged in two parallel rows of 600 elements with a center-to-center spacing of 0.25 mm. All 1200 elements are read out simultaneously every 4 ms. A Intel 80486 based computer with a high speed digital signal processing interface is used to control the beamline hardware and to acquire a series of images. The signal-to-noise, linearity and resolution of the system have been measured. Human images have been taken with this system.

22657 (CNIC–00703) **Identification of a nonsense mutation at amino acid 584-arginine of platelet glycoprotein IIb in patients with type I glanzmann thrombasthenia.** Gu Jianming (Jiangsu Inst. of Haematology, Suzhou Medical College (China)); Xu Wenfeng; Wang Xiaodong; Wu Qingyu; Qi Zhengwu; Ruan Changgeng. China Nuclear Information Centre, Beijing, BJ (China). Aug 1993. 12p. (SMC–0089.). Order Number DE94626134. Source: OSTI; NTIS (US Sales Only); INIS.

Using southern blot, the restriction digests of genomic DNAs in eleven patients with Glanzmann thrombasthenia from ten unrelated kindred were probed with a platelet full-length GP IIb cDNA. An abnormal 2.3 kb Taq I fragment and two 1.65 kb and 0.65 kb fragments with reduced band intensity were found in the genes of two affected siblings from a family originated in city Huang Yan of Zhejiang Province. The Taq I digest of the abnormal gene was further probed with three portions of GP IIb cDNA, revealing that the heterozygous mutation was present in the region around exons 15 ≈ 17 of the GP IIb gene. Two primers for polymerase chain reaction (PCR) were then designed, and a 394 bp PCR product was generated and sequenced, indicating that a stop codon was substituted for an Arg codon at amino acid position 584 of GP IIb, and brought about a premature termination of translation and production of a shortened protein. The Western blot analysis showed that GP IIb and GP IIIa at the platelet surface were apparently deficient, it may be ascribed to the rapid turn-over of GP IIIa uncomplexed with the truncated GP II b. The abnormal 2.3 kb Tag I fragment was used as a specific genetic marker to detect the carrier status of the patient's family. The abnormal allele was proved to be derived from the mother, the two affected siblings are double heterozygotes carrying two different GP II b-defective alleles and one clinically unaffected sister has also inherited this defective allele, while the father carries another unidentified recessive abnormal GP IIb-defective allele.

22658 (FRCEA-TH–413) **Contribution to study of mutagen power of atmospheres.** Blaise, P. CEA Centre de Pierrelatte, 26 (France); Montpellier-2 Univ., 34 (France). 25 Sep 1986. 236p. (In French). Order Number DE94769958. Source: OSTI; NTIS (US Sales Only).

After a detailed research in literature on the concerned subject, the toxic risks on human genes presented by atmospheric pollutants in several areas (rural sites, motor way toll, painting work-room) are evaluated, with in vitro mutagenesis tests and with analytic technologies.

22659 (INIS-BR–3312) **Myocardial scintigraphy with gallium-67 in the detection of cardiac acute rejection.** Meneguetti, J.C. Sao Paulo Univ., SP (Brazil). Faculdade de Medicina. 1990. 86p. (In Portuguese). Order Number DE94626135. Source: OSTI; NTIS (US Sales Only); INIS.

In order to evaluate the myocardial scintigraphy with Gallium-67 potentiality in the detection of acute rejection phenomenon, 105 studies were performed in 20 patients after they had a heart transplantation. The scintigraphic images were obtained by a conventional camera-computer system. These images were acquired 48 hours after all the patients were given an intravenous injection of 111 MBq of Gallium-67 Citrate. The biopsies were done according to the Mason technique and the histological analysis followed the Billingham standards. (author).

22660 (INIS-BR–3313) **Studies about the stress transaxial myocardium tomography with thallium -201.** Rocha Pantoja, M. da. Universidade Federal, Rio de Janeiro, RJ (Brazil). Faculdade de Medicina. 1987. 126p. (In Portuguese). Order Number DE94626136. Source: OSTI; NTIS (US Sales Only); INIS.

Since the time of earliest applications of SPECT technology to Thallium-201 myocardial perfusion imaging, there has been no agreement as to what constitutes the best procedures to follow in order to achieve the theoretical advantages of SPECT to diagnose coronary artery disease. The purpose of these studies are to show the results of experimental and clinical investigations, that, have helped to resolve most of some controversies. Myocardial perfusion SPECT with Thallium-201 is clinically useful procedure that is readily applicable for routine clinical application provided correct techniques are utilized. (author).

22661 (INIS-BR–3328) **Liquid dynamic in the retroperitoneum: study of albumin labelled with iodine-131.** Steinman, E. Sao Paulo Univ., SP (Brazil). Faculdade de Medicina. 1990. 129p. (In Portuguese). Order Number DE94626137. Source: OSTI; NTIS (US Sales Only); INIS.

The retroperitoneal region in not very well-known, specially what concerns its behavior and dynamics, when there is presence of blood and other collections. Therefore, we decided to study the dissemination of the absorption of liquids, using for that a radioactive indicator deposited in different areas of the retroperitoneum. The chosen indicator was iodinated albumin (RIHSA). This study was performed in patients submitted to different types of surgical procedures, but in those who did not present retroperitoneum affections or previous surgeries. In all patients, the blood concentration rate of the indicator in determined times was determined and also the scintilografic image with 24, 48 and 72 hours after finished the surgical procedure was undertaken. It was observed that in the retroperitoneum, the indicator tend to be concentrated in the same place as it was injected at least up to 72 hours and that in the peritoneum the indicator migrates earlier to the abdominal cavity. Besides, the blood transference in retroperitoneum is performed on a slower manner when compared to the peritoneum, except for the anterior para renal area. Radioactive iodine injected in the retroperitoneum was earlier captured by the thyroid. The adopted technique is inocuous, simple, reproductible and quantified. (author).

22662 (LBL–35418) **Heavy Ion therapy: Bevalac epoch.** Castro, J.R. Lawrence Berkeley Lab., CA (United States). Oct 1993. 10p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC03-76SF00098. CA19138. (CONF-9310299–2: Symposium on hadron

therapy, Como (Italy), 18-21 Oct 1993). Order Number DE94011904. Source: OSTI; NTIS; INIS; GPO Dep.

An overview of heavy ion therapy at the Bevelac complex (SuperHILac linear accelerator + Bevatron) is given. Treatment planning, clinical results with helium ions on the skull base and uveal melanoma, clinical results with high-LET charged particles, neon radiotherapy of prostate cancer, heavy charged particle irradiation for unfavorable soft tissue sarcoma, preliminary results in heavy charged particle irradiation of bone sarcoma, and irradiation of bile duct carcinoma with charged particles and-or photons are all covered. (GHH)

22663 (UCRL-JC-115855) **Detection of the electrocardiogram P-wave using wavelet analysis.** Anant, K.S. (California Univ., Davis, CA (United States). Dept. of Applied Science); Rodrigue, G.H.; Dowla, F.U. Lawrence Livermore National Lab., CA (United States). Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940449-7: Society of Photo-Optical Instrumentation Engineers conference on intelligent information systems, Orlando, FL (United States), 4-8 Apr 1994). Order Number DE94010791. Source: OSTI; NTIS; GPO Dep.

Since wavelet analysis is an effective tool for analyzing transient signals, we studied its feature extraction and representation properties for events in electrocardiogram (EKG) data. Significant features of the EKG include the P-wave, the QRS complex, and the T-wave. For this paper the feature that we chose to focus on was the P-wave. Wavelet analysis was used as a pre-processor for a backpropagation neural network with conjugate gradient learning. The inputs to the neural network were the wavelet transforms of EKGs at a particular scale. The desired output was the location of the P-wave. The results were compared to results obtained without using the wavelet transform as a pre-processor.

5507 Microbiology

Refer also to citation(s) 20939, 20980, 21070

22664 (DOE/ER/60989-4) **Microbial communities in subsurface environments: Diversity, origin, and evolution: Project technical progress report, September 1, 1993–August 31, 1996.** Nierzwicki-Bauer, S.A. Rensselaer Polytechnic Inst., Troy, NY (United States). 2 May 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60989. Order Number DE94013699. Source: OSTI; NTIS; GPO Dep.

This report summarizes the progress made from 9-1-93 to 5-1-94 on this DOE grant. As participants in the subsurface science program, the authors are assessing the influence of environmental conditions on the distribution and evolution of subsurface microorganisms employing molecular techniques. The approach utilizes 16S rRNA targeted oligonucleotide probes, polymerase chain reaction (PCR) amplification of gene sequences, and sequencing techniques. Continued progress towards identifying target sequences for selected microbial types and groups is being made by analysis of rRNA sequence data for subsurface microorganisms and other microorganisms in the rRNA databases. Hybridization probes for these target sequences are being produced and used to classify isolated strains of subsurface microbes into focus clades useful for testing origins hypotheses.

22665 (DOE/MC/27226-3740) **Development of biological coal gasification (MicGAS Process): Fifteenth quarterly report, [January 1, 1994–March 31, 1994].** Srivastava, K.C. ARCTECH, Inc., Chantilly, VA (United States). 26 Apr 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27226. Order Number DE94012521. Source: OSTI; NTIS; GPO Dep.

Maximum methane production was obtained in the experimental vials that contained 0.2% SNTM supplemented with 10 mM sodium citrate and 1% TxL (144 cc), while in the control vials CH_4 production was only 58 cc. The conversion efficiency was 24%. This clearly shows citrate to be an important mediator for the formation of acetate (main precursor for CH_4 formation) in the glyoxylate cycle, on the one hand, and as a sequestering agent, on the other. These results further indicate that citrate can, be successfully used as co-substrate for enhancement of the TxL biogasification process. The results obtained reconfirmed our hypothesis that the metals (such as Fe^{3+}, Mn^{2+}, Mg^{2+}, CO^{2+}, Zr^{2+}, etc., present in the coal structure) are chelated/sequestered by the addition of citrate. Mass balance calculations show that this increase in CH^4 production is due to the biomethanation of TxL and not because of the chemical conversion of co-substrate(s) to CH_4 (Table 1). The effect of sodium citrate on biomethanation of TXL from the first experiment "Effect of co-substrate addition No. 1" was reconfirmed in this experiment. The peak in acetate concentration (1317 ppm) on day 7 was followed by a rapid conversion of this precursor to CH_4 (Figure 16). The VFA data obtained from both experiments ("Effect of co-substrate addition No. 1 and No. 2") confirms the hypothesis that citrate and methanol can significantly enhance the biomethanation of TxL (Figure 17).

22666 (LA-12789-MS) **Numerical simulations in support of the in situ bioremediation demonstration at Savannah River.** Travis, B.J.; Rosenberg, N.D. Los Alamos National Lab., NM (United States). Jun 1994. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013199. Source: OSTI; NTIS; INIS; GPO Dep.

This report assesses the performance of the in situ bioremediation technology demonstrated at the Savannah River Integrated Demonstration (SRID) site in 1992–1993. The goal of the technology demonstration was to stimulate naturally occurring methanotrophic bacteria at the SRID site with injection of methane, air and air-phase nutrients (nitrogen and phosphate) such that significant amounts of the chlorinated solvent present in the subsurface would be degraded. Our approach is based on site-specific numerical simulations using the TRAMP computer code. In this report, we discuss the interactions among the physical and biochemical processes involved in in situ bioremediation. We also investigate improvements to technology performance, make predictions regarding the performance of this technology over long periods of time and at different sites, and compare in situ bioremediation with other remediation technologies.

5508 Morphology

Refer also to citation(s) 22737

5509 Pathology

Refer also to citation(s) 21181, 22675

5510 Physiological Systems

Refer also to citation(s) 22669, 22739

5520 Public Health

Refer also to citation(s) 22651

5530 Agriculture and Food Technology

Refer also to citation(s) 21148, 22141, 22525, 22647, 22649, 22712

22667 (CNIC-00724) **Plant mutation breeding and application of isotopic tracer in Chinese agriculture.** Liang Qu (Institute for Application of Atomic Energy, CAAS (China)). China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 11p. (CSNAS-0069.). Order Number DE94626007. Source: OSTI; NTIS (US Sales Only); INIS.

The progress and achievements made in plant mutation breeding and application of isotopic tracer in Chinese agriculture are outlined. Plant mutation breeding is well developed not only in improvement of crops but also in methodology of mutation induction. More than 325 mutant varieties and hundreds of various valuable mutants of 29 different species have been obtained. The mutant cultivars released have covered more than 10 million hectares in total area. The systematic studies on methodology such as techniques for mutagenic treatment, development of various mutagens,

screening and selecting techniques of mutation etc. have been carried out in China. The techniques of radioisotopic tracer used in many research fields are described. Application of isotopic tracer in studies of fertilization and plant nutrition, environment protection, nitrogen-fixation, animal production and diagnosis of diseases, and so on, have made great achievements and benefits in China. Many kinds of labelled compounds, especially of labelled agro-chemicals have been synthesized in the Institute for Application of Atomic Energy (IAAE). Chinese Academy of Agricultural Sciences (CAAS). The proposals for the region cooperation in Asia on application of atomic energy in agriculture are included.

22668 (CNIC–00739) **Antibody-targeted thrombus imaging and thrombolysis.** Wu Guoxin (Suzhou Medical Coll., JS (China)); Ruan Changgeng. China Nuclear Information Centre, Beijing, BJ (China). May 1993. 11p. (In Chinese). (SMC–0095.). Order Number DE94626018. Source: OSTI; NTIS (US Sales Only); INIS.

In respect of thrombus imaging, the femoral arterial or venous thrombus model was prepared in dogs and imaged with single photon emission computerized tomography (SPECT). After 4 hours of injection of ^{131}I-SZ-51 the radioactivity ratio between thrombus and blood (T/B) was 18 : 1 and 8 : 1 for arterial and venous thrombus respectively. The result conformed with the T/B ratio of the removed thrombus and blood after 24 hours of injection of radiotracer. It indicates that the McAb SZ-51 has a great potential to bind with thrombus. In respect of thrombolysis, the Fab(fragment, antigen-binding) fragment of McAb SZ-51 was chemically conjugated of urokinase (UK) by the disulfide-linking reagent SPDP and 2-iminothiolane. The resulting conjugate was 3 to 5 times as potent as UK in vitro in human platelet-rich plasma assay. The increase of fibrinolytic potency was accompanied by a decrease of consumption of plasminogen and fibrinogen. It shows that the increase of potency is the result of selectivity increase.

22669 (CNIC–00745) **Study on increasing mutagenic efficiency of radiation breeding for rice.** Wan Xianguo (Hunan Academy of Agricultural Sciences, Changsha (China). Inst. for Application of Atomic Energy); Pang Boliang; Zhu Xiaoqi; Hu Nenshu; Zhu Zerui. China Nuclear Information Centre, Beijing, BJ (China). Apr 1993. 6p. (In Chinese). (CSNAS–0070.). Order Number DE94626008. Source: OSTI; NTIS (US Sales Only); INIS.

Increasing mutagenic efficiency and improving selection method are of important topics for crop mutation breeding. Investigation on the radiation breeding for rice (Oryza Sativa L.) showed that the crossing in combination with gamma ray irradiation or laser irradiation and proper selection of dosage rate can increase mutagenic efficiency. According to the correlation of phenotype in M_1 generation and mutation frequency in M_2 for rice, the materials with certain characters were chose as seeds, thus the works of generation selections will be reduced.

22670 (DOE/BP/01385–4) **Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River: Annual report 1993.** Knapp, S.M. (ed.). Oregon Dept. of Fish and Wildlife, Portland, OR (United States); Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR (United States). Mar 1994. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-89BP01385. Order Number DE94013088. Source: OSTI; NTIS; GPO Dep.

This report presents progress from October 1992 through September 1993 in evaluating juvenile fish bypass facilities at Three Mile Falls, Maxwell, Westland, and Feed Canal dams on the Umatilla River, and in evaluating adult fish passage in the lower Umatilla River. Also reported is an effort to evaluate delayed mortality and stress responses of juvenile salmonids resulting from trapping and transport at high temperatures. These studies are part of a program to rehabilitate anadromous fish stocks in the matilla River Basin, including restoration of coho salmon and chinook salmon, as well as enhancement of summer steelhead.

22671 (DOE/BP/21182–4) **Idaho habitat/natural production monitoring part III: Annual report 1993.** Schrader, W.C.; Petrosky, C.E. Idaho Dept. of Fish and Game, Boise, ID (United States). Fisheries Research Section. Mar 1994. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP21182. Order Number DE94013089. Source: OSTI; NTIS; GPO Dep.

Effective management of wild anadromous fisheries is partly dependent on defining relationships between escapement and production. These productivity relationships (or reproduction curves) depend on the nature of density-dependent mechanisms that control the population. Inherent is developing any relationship is specifying the fish population of interest and what is meant by escapement and production by that population. This report is a summary of sampling programs at all existing and proposed anadromous fish weirs in Idaho as of fall 1992. Only permanent or semi-permanent structures where long-term data could be collected are included. The summary is stratified by class of fish and by cell or drainage using the same classifications as the Idaho Anadromous Fish Management Plan. Included in the summary are escapement objectives above the existing and proposed weirs. Recommendations based on this summary were developed to provide coverage for all classes and most major drainages, yet minimize cost and duplication of efforts. this was a usefull approach as some chinook salmon weirs were identified that could be modified to monitor steelhead trout.

22672 (DOE/ER/13214–8) **Effects of freezing and cold acclimation on the plasma membrane of isolated protoplasts: [Annual report], May 16, 1993–January 29, 1994.** Steponkus, P.L. Cornell Univ., Ithaca, NY (United States). Dept. of Soil, Crop and Atmospheric Sciences. [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13214. Order Number DE94012487. Source: OSTI; NTIS; GPO Dep.

Our aim is to provide a mechanistic understanding of the cellular and molecular aspects of freezing injury and cold acclimation from a perspective of the structural and functional integrity of the plasma membrane-the primary site of freezing injury in winter cereals. We established that destabilization of the plasma membrane of winter rye, the most freezing-tolerant winter cereal, can result from several different lesions: expansion induced lysis, lamellar-to-hexagonal II phase transitions, and the fracture-jump lesion. The occurrence and incidence of these various lesions, depends on the freeze/thaw protocol and the stage of cold acclimation. In non-acclimated leaves and protoplasts, expansion-induced lysis is the predominant lesion at temperatures between −2 and −5°C, whereas freeze-induced formation of the H_{II} phase is the predominant lesion at temperatures below −10°C. We investigated whether the difference in freezing tolerance and the threshold temperatures at which the lesions occur in rye and oat are a consequence of differences in the lipid composition of the plasma membrane. There are substantial differences between rye and oat cell membranes both before and after cold acclimation. The plasma membrane of oat contains greater proportions of acylated sterylglucosides and cerebrosides than that of rye, and there is little change in these two lipid classes during cold acclimation. The lyotropic phase behavior of lipid mixtures that resemble the plasma membrane of rye and oat was studied. The differences in lipid composition of rye and oat are of mechanistic significance because of their influence on the hydration characteristics of the plasma membrane, the propensity for dehydration-induced lipid-lipid demixing, and the intrinsic curvature of the lipid monolayers. These studies suggest that strategies for improving the freezing tolerance of winter cereals should include approaches to modify membrane lipid composition.

22673 (DOE/ER/20084–1) **Program and abstracts: IS-MPMI sixth International Symposium on Molecular Plant-Microbe Interactions.** Washington Univ., Seattle, WA (United States). [1992]. 202p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States);Department of Agriculture, Washington, DC (United States). DOE Contract FG06-92ER20084. Grant 9207289. (CONF-9207238–Absts.: 6. international symposium on molecular plant-microbe interactions, Seattle, WA (United States), 11-16 Jul 1992). Order Number DE94012610. Source: OSTI; NTIS; GPO Dep.

This volume provides abstracts of oral and poster presentations made for the Sixth International Symposium on Molecular Plant-Microbe Interactions.

22674 (INIS-BR–3320) **Use of ^{60} Co gamma radiation to expend the shelf life of packaged sliced loaves.** Nazato, R.E.S. Centro de Energia Nuclear na Agricultura (CENA), Piracicaba, SP (Brazil). Nov 1991. 76p. (In Portuguese). Order Number DE94626014. Source: OSTI; NTIS (US Sales Only); INIS.

The evaluation of conservation of sliced loaves (bread cut into slices). baked by five bakeries of Piracicaba, after gamma irradiation and maintained into polyethylene begs of low density, of 47,5 and 85 μm of thicknesses is shown. The sliced loaves were put into the bags and thermo-sealed by hand, like they were handled by the bakers. After this, they were irradiated with doses of 0.0: 2.0; 4.0; 6.0; 8.0 and 10.0 kGy of gamma radiation in a irradiation chamber of Cobalt-60 at a dose rate of 2,68 kGy per hour, at the room temperature (28^0 C). After irradiation the samples were maintained under at the room temperature (26 - 34^0 C), and humidity, as similar as possible to the conditions of the markets, bakeries and shops they were sold. The samples were evaluated every days and if any of them presented sign of contamination. It was threw away because it was inappropriate for human consumption. (author).

22675 (INIS-BR–3321) **Distribution of (^{14} C) photosynthates in 3 periods during the plant-cane cycle.** Pimentel, R.M.M. Universidade Federal Rural de Pernambuco, Recife, PE (Brazil). Apr 1989. 74p. (In Portuguese). Order Number DE94626009. Source: OSTI; NTIS (US Sales Only); INIS.

Plant-cane stools were labelled with ^{14} CO_2 in the field, at Goiana-PE, Brazil, when 3,7 and 11 months old. Each stool was enclosed in a chamber with ^{14} CO_2 for 90 minutes. The ^{14} C photosynthates were measured in leaves, stalks, roots and soil 1, 7, 15, 30, 60 and 90 days after labelling. Roots were divided into alive and dead and soil into rizosphere and outer soil. The soil was incubated for 10 days to measure C mineralization. At end of the labelling period at 3,7 and 11 months, 2, 19 and 1% of the initial ^{14} CO_2 were recovered in the plant and the soil. The low recovery of ^{14} C at 3 months could be attributed to losses by respiration and lack of sampling of the top growing point. The low CO_2 fixation and losses by respiration at first sampling in the 7 months old labelling were attributed to low light intensity during the day of labelling. In the following sampling, total ^{14} C recoveries varied little and there was little change in the proportion of ^{14} C in each part, indicating that the ^{14} C was already incorporated in stable organic fractions. Most of the recovered ^{14} C C>80%) was founded in the leaves but all plant parts received labelled photosynthates. (author).

22676 (PNL-SA–23735) **The significant human-animal bond: Pets with cancer.** Weller, R.E. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9403108–4: Post-graduate course in veterinary oncology, Santiago (Chile), 22-24 Mar 1994). Order Number DE94011677. Source: OSTI; NTIS; GPO Dep.

Veterinarians have responsibilities to both the animal and its owner. In the past several years there has been an increased awareness and concern about human-animal bonds. As a result, we have begun to appreciate the nature, strength, and significance of bonds that develop between humans and companion animals. It is typical for a pet to be perceived as and treated as a member of the family and as a result, animals provide special and beneficial relationships for many years. It is partly because of this role of the pet in promoting human health and happiness that we as veterinarians have an obligation to assist both owner and animal. The mark of the good practitioner concerns not only the ability to diagnose and treat accurately, but also the ability to show understanding and compassionate judgement.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 21064, 21068, 21078, 21079, 21080, 21084, 21097, 21375, 21376, 21384, 21385, 21386, 21388, 21647, 21655, 22063, 22064, 22117, 22119, 22130, 22136, 22137, 22138, 22349, 22374, 22528, 22617, 23226, 23299

22677 (BfS-ISH–164/93) **Levels for the specific activity at disposing low-level contaminated municipal wastes.** Poschner, J.; Schaller, G. Bundesamt fuer Strahlenschutz, Neuherberg (Germany). Inst. fuer Strahlenhygiene. Dec 1993. 193p. (In German). Order Number DE94773853. Source: OSTI; NTIS (US Sales Only); INIS.

Using radioecological models, nuclide-specific "basic values" were established for the specific activity of radioactive contaminated waste. These basic values were determined in order to avoid dose equivalents of more than 10 μSv/a (de minimis concept) when disposing the waste in conventional waste deposits or burning it in incineration plants. The basic values vary within 16 orders of magnitude, ranging between 4.3E-02 Bq/g for Cm-250 and 2.2E+14 Bq/g for Po-212. About 82% of the basic values are between 1 Bq/g und 1000 Bq/g. The critical exposure for most of the radionuclides is that from direct radiation or inhalation at the slag-deposit. For 54% of the radionuclides the basic value for the specific activity of waste is lower at least by a factor of 10 than the 10^{-4}-fold value per gram of the release limit (German Radiation Protection Ordinance). Appropriate nuclide-specific and dose-related limits were derived from these basic values. The respective limits are ranging between 1E-01 Bq/g and 1E+07 Bq/g. About 95% of the limits are between 1 Bq/g and 1000 Bq/g. (orig./HP)

22678 (BNWL–620) **Pacific Northwest Laboratory monthly activities report, October 1967.** Albaugh, F.W. Pacific Northwest Lab., Richland, WA (United States). Nov 1967. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012038. Source: OSTI; NTIS; GPO Dep.

Declassified.

The results of a statistical study of Columbia River temperature trends were released on October 18 at the Sixth WSU Hydraulics Conference. The new John Day reservoir is under study for possible beneficial effects on flow regulation. Measurements of radioactivity in 396 children were completed at Captain Gray elementary school, Pasco, Washington on October 19, 1967. Measurements began at the Emerson elementary school in Pasco on October 24, 1967, following lectures to the teaching staff and to each of the 18 classrooms in grades 1 through 6. Computer programming was started in October to determine the frequency distribution, mean, and median values of the environmental radiation dose values calculated last month from several thousand individual adult diet records. Response or game bird hunter-employees to a request for participation in a survey of game bird kills during the current season has been disappointing in spite of several articles in the project newspapers.

22679 (BNWL–2164) **Radioactive fallout from Chinese nuclear weapons test.** Thomas, C.W.; Soldat, J.K.; Silker, W.B.; Perkins, R.W. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. 26 Sep 1976. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94007821. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Radioactive fallout from this Chinese nuclear test resulted in measurable deposition of short-lived debris over much of the United States. The fallout levels varied by more than 1000-fold and showed significant temporary or spatial fractionation with higher levels of deposition being associated with rain. The particle size with which the airborne debris was associated decreased continuously with time following detonation and a substantial fraction of the ^{131}I was associated with inorganic and organic gases. The potential radiation dose to an infant consuming milk produced at the location of the highest concentration of ^{131}I measured on grass was estimated to be ~1 rem. This dose is about 50 times the annual dose received in the vicinity of a power reactor operating under the existing US Nuclear Regulatory Commission design guides. The potential upper limit thyroid dose for the population of 17 eastern seaboard states from this single test was estimated to be about 2.4 $\times$ 10^6 man-thyroid-rem under the assumption that all dairy cows remained on fresh pasture throughout the month following the initial decomposition of fallout debris. This dose is about

200 times the estimated dose from currently operating nuclear power reactors and about 50 times the annual US population thyroid dose that would be received from 500 GWe of nuclear power reactors in the year 2000.

22680 (CNIC–00754) **Absorbed doses to the main parts of eyeball due to use $^{90}Sr + ^{90}Y$ ophthalmic applicator.** Chen Lishu (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). China Nuclear Information Centre, Beijing, BJ (China). May 1993. 11p. (In Chinese). (IAE–0117.). Order Number DE94626046. Source: OSTI; NTIS (US Sales Only); INIS.

The ophthalmic radiotherapy dosimetry and some affecting factors are introduced. The distributions of absorbed doses to the main parts of a fresh eyeball such as the cornea, sclera, lens and anterior chamber, during the radiotherapy by using a $^{90}Sr + ^{90}Y$ ophthalmic applicator are presented. An tissue-equivalent extrapolation ionization chamber was used in the dose measurement. The reasonable doses during ophthalmic radiotherapy for different depths have been obtained. Therefore, the absorbed dose to the lens, the most sensitive organ, can be given. These data are useful for radiation protection in ophthalmic radiotherapy.

22681 (CNIC–00762) **Effects of exogenous and endogenous IL-2 on irradiated human peripheral blood lymphocytes.** Zhang Lansheng (Suzhou Medical Coll., JS (China)); Wang Ninghai; Luan Meiling. China Nuclear Information Centre, Beijing, BJ (China). Aug 1993. 9p. (SMC–0096.). Order Number DE94625957. Source: OSTI; NTIS (US Sales Only); INIS.

Human peripheral blood lymphocytes were irradiated with 1 to 40 Gy of γ-ray, and then cultured with PHA to prepare supernatant containing IL-2 for observation of kinetics of endogenous IL-2 production and reversion of lymphocyte proliferation after adding a highly purified IL-2. IL-2 activity was determined by the ability to sustain IL-2 dependent cell line (CTLL), lymphocyte proliferation was determined by ^{3}H-TdR incorporation and T lymphocyte subsets by monoclonal antibodies. The experimental results showed that lymphocytes exposed to ^{60}Co synthesized less DNA than non-irradiated lymphocytes. The inhibitory effect can partially reversed by purified IL-2 at the γ-ray dose range of 1 to 10 Gy, while irradiation with 2.5 Gy resulted in a reduction of T cells and T subsets, and increase in CD^{+}_{4}/CD^{+}_{8} ratio. The ratio of subsets recovered after adding IL-2. The kinetics of IL-2 production showed that the endogenous IL-2 production rose markedly with increasing dose of irradiation at the range of 1 to 10 Gy, and the peak of IL-2 production was at the γ-ray dose of 10 Gy.

22682 (CNIC–00765) **The immunotoxicological effects of enriched UO_2F_2 on DNA replicative synthesis in different immune cells.** Yang Zhanshan (Suzhou Medical Coll., JS (China)); Zhu Shoupeng. China Nuclear Information Centre, Beijing, BJ (China). Aug 1993. 7p. (In Chinese). (SMC–0097.). Order Number DE94626001. Source: OSTI; NTIS (US Sales Only); INIS.

The immunotoxicological effects of enriched UO_2F_2 on DNA replication synthesis in PHA-, ConA- and LPS-stimulated splenocytes, thymocytes and bone marrow cells from purebred BALB/c male mice were studied by [^{3}H] thymidine (^{3}H-TdR) incorporation assay. The results indicated that in splenic T, B lymphocytes and thymocytes ^{3}H-TdR incorporation reduced significantly ($P<0.05$ or 0.01) after intake of enriched UO_2F_2 at dose of $10 \approx 500$ μg/kg. However, in PHA-stimulated splenic T lymphocytes ^{3}H-TdR incorporation increased significantly ($P<0.05$) as compared with the control group after intake of enriched UO_2F_2 at dose of 0.1 μg/kg, showing a stimulatory effect of enriched UO_2F_2 on DNA replicative synthesis in splenic lymphocytes. The higher the radiosensitivity of the different lymphocytes is, the lower the doses of radionuclides inducing stimulatory effect are. The data were fitted to a linear-quadratic model by curvilinear regression. In addition, ^{3}H-TdR incorporation rate still did not recover after 14 d enriched UO_2F_2 exposure.

22683 (CONF-940406–13) **Microwave concrete decontamination - Phase II results.** White, T.L.; Foster, D. Jr. Oak Ridge National Lab., TN (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on decontamination and decommissioning; Knoxville, TN (United States); 27-29 Apr 1994. Order Number DE94013269. Source: OSTI; NTIS; GPO Dep.

This report documents the results of the second phase of a four-phase development program to develop a system to decontaminate concrete using microwave energy. In the first phase of the program the feasibility of using microwaves to remove concrete surfaces was demonstrated. In the first phase experiments, concrete slabs were placed on a translator and moved beneath a stationery microwave system. The second phase demonstrated the ability to mobilize the technology to remove the surfaces from concrete floors. Phases III and IV will further develop the technology to be remotely operated and capable of removing concrete from floors as well as from vertical surfaces.

22684 (DOE/FTR–94005433) **Travel to France to develop detailed plans for a book on cancer risk due to low doses of radiation: Foreign trip report, January 8–12, 1994.** Gilbert, E.S. Pacific Northwest Lab., Richland, WA (United States). 17 Jan 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94005433. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this meeting was to develop detailed pans for a book on cancer risk due to low doses of radiation. The book, which will be published by the International Agency for Research of Cancer (IARC), is being planned and written by scientist from several countries who are directly involved in several of the largest and most informative new epidemiologic studies of radiation risks.

22685 (DOE/RL–93-14) **Application for Approval of Modification for the 105-KE Basin Encapsulation Activity.** USDOE Richland Field Office, WA (United States). Mar 1993. 46p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94011454. Source: OSTI; NTIS; GPO Dep.

This application is being submitted to US EPA pursuant to Title 40, Code of Federal Regulations, Part 61.07, amended. The encapsulation activity will consist of the activities necessary to complete encapsulation of the fuel elements and sludge in 105-KE basin, a storage basin for irradiated N Reactor fuel in Hanford 100-K Area; it currently stores 1,150 MTU of N Reactor irradiated fuel elements transferred to the basin from 1975 through 1989. The application presents the chemical and physical processes relating to the encapsulation activity, source term, expected annual emissions, radionuclide control and monitoring equipment, and projected dose to the maximally exposed individual.

22686 (ENEA-RT-AMB–93-14) **X and gamma ray radiation personnel dosimetry services: Technical reliability verification criteria.** ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Oct 1993. 50p. (In Italian). (RT/AMB–93-14). Order Number DE94775230. Source: OSTI; NTIS (US Sales Only).

With the aim of developing an Italian national normative governing the certification of x and gamma ray radiation personnel dosimetry services, ENEA (Italian Agency for New Technology, Energy and the Environment) formed a group of personnel dosimetry experts and entrusted them with the responsibility of performing service reliability checks for personnel dosimetry agencies that wished to have the reliability of their work verified. This document contains a list of standards, which must be met by the dosimetry agencies, as well as, a set of reliability verification procedures and definitions of standardized terminology.

22687 (ENEA-RT-AMB–93-17) **Special x and gamma ray radiation personnel dosimetry for extremities and eyes: Dosimetry services technical reliability verification criteria.** ENEA, Bologna (Italy). Area Energia Ambiente e Salute. Oct 1993. 49p. (In Italian). (RT/AMB–93-17). Order Number DE94775229. Source: OSTI; NTIS (US Sales Only).

With the aim of developing an Italian national normative governing the certification of agencies performing special x and gamma ray radiation personnel dosimetry for the extremities and eyes, ENEA (Italian Agency for New Technology, Energy and the Environment) formed a group of personnel dosimetry experts and entrusted them with the responsibility of performing service reliability checks for the personnel dosimetry agencies that wished to have the reliability of their work verified. This document contains a list of standards, which must be met by the dosimetry agencies, as

well as, set of reliability verification procedures and definitions of standardized terminology.

22688 (ETDE/IT-mf–94775320) **Somatic effects of low neutron doses.** Rebessi, S. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Di Majo, V.; Coppola, M.; Saran, A.; Pazzaglia, S.; Covelli, V.; Pariset, L. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. 1993. 4p. Order Number DE94775320. Source: OSTI; NTIS (US Sales Only).

Growing concern has emerged about the biological effectiveness of low radiation doses and dose rates as evidenced by the new recommended dose limits. Risk estimates rely heavily on the results of low dose in vivo effects investigations. Since some uncertainty still exists regarding these results, large scale experiments on mice irradiated with graded neutron doses were conducted at the Casaccia labs of ENEA (Italian Agency for New Technology, Energy and the Environment) to obtain life span observations. Based on the results of the analysis of survival and tumor incidence data, it was determined that, within the limits represented by the size of these experiments, neutron effectiveness was not evident at doses below 4 cGy for females and 10 cGy for males, at least for the long term parameters examined and for the hybrid mice used.

22689 (ETDE/IT-mf–94775323) **Cytogenetic study in lymphocytes from children exposed to ionizing radiation after Chernobyl accident.** Padovani, L. (ENEA, Casaccia (Italy). Area Energia Ambiente e Salute); Mauro, F.; Caporossi, D.; Tedeschi, B.; Vernole, P.; Nicoletti, B. ENEA, Casaccia (Italy). Area Energia Ambiente e Salute. 1993. 17p. Order Number DE94775323. Source: OSTI; NTIS (US Sales Only).

This study concerns the monitoring of children from the Byelorussian, Ukrainian and Russian republics exposed to the fall-out of the Chernobyl accident. Cytogenetic analyses were performed on 41 children coming from different areas and exhibiting varying amounts of ^{137}Cs internal contamination, as evaluated by whole body counter (WBC) analysis. It was found that on a total of 28,670 metaphases scored, radiation-induced chromosome damage is still present, although at a very low frequency. Due to the very low fraction of dicentrics, because of the time elapsed from the accident and the relatively low doses of exposure, radiobiological dosimetry is not possible for these children. However, considering that the WBC data indicate that the children are still exposed to ^{137}Cs contamination, the observed occurrence of stable chromosome rearrangements and breaks may represent the persisting effect of continuous low doses of radiation. The study also indicates that the parallel use of internal contamination dosimetry and cytogenetics could be usefully employed to monitor individual exposure to radiation and to define further management measures.

22690 (INIS-BR–3315) **In vivo study about specific captation of ^{125} I-insulin by rat brain structures.** Sanvitto, G.L. Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Curso de Posgraduacao em Ciencias Biologicas. 1986. 75p. (In Portuguese). Order Number DE94626002. Source: OSTI; NTIS (US Sales Only); INIS.

The specific captation of ^{125} I-insulin was evaluated by brain structures, as olfactory bulbous, hypothalamus and cerebellum in rats, from in vivo experiences that including two different aspects: captation measure of ^{125} I-insulin after the intravenous injection of the labelled hormone, in fed rats and in rats with 48 h of fast or convulsion, procedure by the pentylene tetrazole; captation measure of ^{125} I-insulin after intra-cerebral-ventricular injection of the labelled hormone in fed rats. (C.G.C.).

22691 (INIS-JP–018, pp. 89-93) **Simplified calculation method for radiation dose under normal condition of transport.** Watabe, N. (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Abiko Research Lab.); Ozaki, S.; Sato, K.; Sugahara, A. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

In order to estimate radiation dose during transportation of radioactive materials, the following computer codes are available: RADTRAN, INTERTRAN, J-TRAN. Because these codes consist of functions for estimating doses not only under normal conditions but also in the case of accidents, when nuclei may leak and spread into the environment by air diffusion, the user needs to have special knowledge and experience. In this presentation, we describe how, with a view to preparing a method by which a person in charge of transportation can calculate doses in normal conditions, the main parameters upon which the value of doses depends were extracted and the dose for a unit of transportation was estimated. (J.P.N.).

22692 (INIS-JP–018, pp. 645-653) **Proposal of the standard for dose rate increase under normal test conditions.** Akamatsu, H. (Kobe Steel Ltd. (Japan)); Taniuchi, H.; Iida, T.; Ozaki, S.; Watabe, W.; Satoh, K. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The object of this research is to propose an updated and more justifiable standard for dose rate increase under normal test conditions than that adopted in the IAEA Transport Regulations, the 1985 edition, taking into account the evaluated influence of deformations in the package on the surrounding radiation field and the difference of exposure level according to the method of operation of the transport operator. An analysis of the neutron shielding using a simplified model of a package containing neutron sources permitted us to confirm that neutrons have similar tendencies to those of gamma rays. In order to avoid accidental exposure of the public and/or the transport operators to radiation, the surrounding radiation field of a package should be maintained as stable as possible under normal conditions. It was confirmed that, regarding the provision concerning the increase rate of the radiation level of a package specified in the 1985 IAEA Transport Regulations, it is more accurate and reasonable to specify a provision as a design standard for the package, using the radiation level increase rate at points one meter from the package surface, since it more accurately represents any changes in the surrounding radiation field. (J.P.N.).

22693 (INIS-JP–018, pp. 792-798) **Conservatism of RADTRAN line-source model for estimating worker exposures.** Weiner, R.F. (Western Washington Univ., Bellingham, WA (United States)); Neuhauser, K.S. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

Using a spent fuel cask as an example, the authors calculated dose rates at various distances with the RADTRAN method and compared these results to dose rates calculated with equations that more exactly describe the actual field around a cask. The former are shown to be conservative (i.e., to overestimate dose) for all distances, even though the latter equations explicitly account for surface albedo while the RADTRAN model does not. (J.P.N.).

22694 (INIS-JP–018, pp. 799-806) **A methodology for the transfer of probabilities between accident severity categories.** Whitlow, J.D. (Sandia National Labs., Albuquerque, NM (United States)); Neuhauser, K.S. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

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This paper will describe a methodology which has been developed to allow accident probabilities associated with one severity category scheme to be transferred to another severity category scheme, permitting some comparisons of different studies at the category level. In this methodology, the severity category schemes to be compared are mapped onto a common set of axes. The axes

represent critical accident environments (e.g., impact, thermal, crush, puncture) and indicate the range of accident parameters from zero (no accident) to the most sever credible forces. The choice of critical accident environments for the axes depends on the package being transported and the mode of transportation. The accident probabilities associated with one scheme are then transferred to the other scheme. This transfer of category probabilities is based on the relationships of the critical accident parameters to probability of occurrence. The methodology can be employed to transfer any quantity between category schemes if the appropriate supporting information is available. (J.P.N.).

22695 (INIS-JP–018, pp. 1231-1236) **The ICRP 60 and the agency's regulations for the safe transport of radioactive material.** Biaggio, A.L. (Brazilian Argentine Agency for Accounting and Control of Nuclear Materials. (Brazil)); Novo, R.G. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The International Commission on Radiological Protection (ICRP) has adopted its new '1990 Recommendations of the International Commission on Radiological Protection in November 1990, they were published in 1991 as 'ICRP Publication 60. Two main scenarios are considered by the new ICRP's recommendations: (a) Protection in proposed and continuing practices (further subdivided as protection against actual exposures and protection against potential exposures); and (b) Protection by intervention. Although intervention means any activity in order to decrease the overall exposure, removing existing sources, modifying pathways or reducing the number of exposed individuals, in relation to the transport of radioactive materials, protection by intervention is related mainly to emergency planning, while protection against actual and potential exposures can be considered as the subject of most of the requirements of the 'Regulations for the Safe Transport of Radioactive Material 'prime of the International Atomic Energy Agency (IAEA). The on-going revision of the IAEA Safety Series No. 9, which is aimed at putting this publication in line with the new ICRP recommendations will, for the first time, provide a convalidated radiological framework for the 1996 revision of the Agency Transport Regulations. However, to adapt to the transport area the radiological principles and criteria will require a significant effort and a carefully evaluation of the overall impact of each change proposed. (J.P.N.).

22696 (INIS-mf–13808, pp. 190) **Radiation protection in the Seibersdorf Research Centre.** Duftschmid, K.E. (Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria). Inst. fuer Strahlenschutz). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SEIBERSDORF RESEARCH CENTRE/ radiation protection

22697 (INIS-mf–13871) **Proceedings of the CTU seminar 94. Pt. B.** Ceske Vysoke Uceni Technicke, Prague (Czech Republic). 30 Apr 1994. 242p. (CONF-940184–: CTU seminar 94, Prague (Czech Republic), 17-20 Jan 1994). Order Number DE94624331. Source: OSTI; NTIS (US Sales Only); INIS.

The proceedings consist of 3 parts (A, B, C). Part B is divided into the following sections: Biomedical Engineering, Computer Art, Informatics and Cybernetics, Electrical and Power Engineering, Communication Engineering, Architecture and Urbanism. Out of 96 short communications contained in this part of the proceedings, 6 items were inputted to the INIS system. Out of 106 (110) short communications contained in parts A (B), 23 (2) items were inputted to INIS. (Z.S.).

22698 (ITRI–139) **Long-term dose-response studies of inhaled or injected radionuclides: Biennial report, 1 October 1991–30 September 1993.** Boecker, B.B.; Muggenburg, B.A.; Miller, S.C.; Bradley, P.L. (eds.). Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst. Jan 1994. 288p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76EV01013. Order Number DE94013674. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the scientific progress in, and current status of, life-span studies of the long-term health risks in Beagle dogs of chronic irradiation from internally deposited radionuclides or from an external source. The reporting period for this document is the 2-year period from October 1, 1991 through September 30, 1993. Studies that were initiated at three different laboratories (Inhalation Toxicology Research Institute, ITRI, University of Utah, and Argonne National Laboratory, ANL) are presented here because they are being completed at ITRI. All living dogs in the Utah-initiated studies were transferred to the ITRI facility for the remainder of their life-span observations and measurements in September 1987. This report is the fourth in a series of reports dealing with the current status and progress of both the Utah and ITRI studies. Other life-span studies involving dogs exposed to gamma radiation from an external source were initiated and conducted for many years at ANL. In 1991, the decision was made to discontinue the chronic irradiation of the remaining living dogs and to transfer all remaining dogs to ITRI for care, clinical observations, and pathological observations at death or euthanasia. This report provides the current status of these dogs. Status reports on the Utah and ITRI studies comprise most of this report. The ITRI-related section presents brief statements of project objectives, the general procedures used in these studies, and some study-specific features for each of the 19 studies being conducted with either beta- or alpha-emitting radionuclides. Dose- and effect-modifying factors being addressed in these studies include total dose, dose rate, LET, solubility, nonuniformity of dose, species, age, sex, health status, and mode of exposure. Recent additions to experimental protocols for studies in which dogs are still alive involve the collection and analysis of tumor tissues using currently available molecular biology techniques.

22699 (KIYaI–91-32) **The investigation of kinetic chemiluminescence characteristics of irradiated animal blood.** AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 20p. (In Russian). Order Number DE93617293. Source: OSTI; NTIS (US Sales Only); INIS.

The parameters of free radical oxidation in dogs irradiated by protons were investigated. The reliable differences of dynamics of luminescence of radiosensitive and radioresistant animals were marked. It was also observed that with local irradiation of the brain considerable differences in blood was observed as compared with whole body irradiation.

22700 (KIYaI–91-33) **Blood chemiluminescence of rats, irradiated by fast neutrons.** AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1991. 16p. (In Russian). Order Number DE93617294. Source: OSTI; NTIS (US Sales Only); INIS.

The state dynamics of free radical processes of oxidation is established in blood of control rats and in radiation exposed animals acutely and after some delay.

22701 (KIYaI–92-13) **The study of dependence of postirradiation rats' mortality on initial values of partial oxygen pressure in hypodermic cellular tissue.** AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1992. 16p. (In Russian). Order Number DE93617318. Source: OSTI; NTIS (US Sales Only); INIS.

The dynamics of animal's mortality after acute gamma radiation at doses of 800, 960, and 1140 cGy was investigated. Mortality was compared with the initial partial oxygen pressure in subdermal space. A positive correlation between the animal radiosensitivity and oxygen pressure was found.

22702 (KIYaI–92-16) **Hematological figures and electrical properties of the lyphocytes in irradiated animals.** AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij. 1992. 12p. (In Russian). Order Number DE93617295. Source: OSTI; NTIS (US Sales Only); INIS.

It was shown that the primary sharp decrease in leucocyte number is clearly dependent on radiation dose. To study the membrane specific radiation action on these cells, the electrophoretic mobility of lymphocytes was measured. The maximum increase in cell mobility was observed 10 days after exposure. Where animals were exposed to 50 cGy as opposed to 100 or 400 cGy doses, a sharp decrease of cell mobility after 20 days.

22703 (NIRS-M–86, pp. 5-13) **Active oxygens and their protection.** Yukawa, Osami (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Most of radiation-induced damages to living organisms are thought to be originated from active oxygens produced from water and oxygen in living organisms by irradiation. These active oxygens react with various intracellular components including DNA, proteins, lipids, carbohydrates and other lower molecular weight substances, then finally induce genetic damages, metabolic damages or abnormality of cell functions. Our studies demonstrated that active oxygens produced by radiation caused peroxidation of biological membrane lipids, resulting in destruction of membrane structure and inactivation of membrane-bound enzymes. The lipid peroxidation might be also one of the most important factors to induce radiation carcinogenesis. Protective substances in several rat tissues and yeast against active oxygens produced by radiation were also investigated and a basic protein which have high content of SH group and three different lower molecular weight substances were separated from rat liver cytosol. These substances have functions to suppress not only radiation-induced lipid peroxidation but also radiation-induced inactivation of membrane-bound enzymes. From these data, effect of active oxygens produced by radiation and their protection in organisms are discussed. (author).

22704 (NIRS-M–86, pp. 23-31) **Host defense and hepatic metallothionein induction.** Matsubara, Junko (Tokyo Univ. (Japan). Faculty of Medicine). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

This is a brief review of my investigations to search a mechanism of the promotion of radioresistance in mice regarding the activation of host defense mechanism which seems to involve chemical as well as immunological protections. Intraperitoneal (i.p.) injection of a metal salt: $MnCl_2$ (10mg Mn/kg) or of a biological response modifier (BRM): IL-1 (40 μg/kg) or OK432 (15mg/kg), or Chinese herbal medicine, Toki (270mg/kg) or Shigoka (250mg/kg), one day prior to 7.5 Gy of X-ray irradiation produced prominent radioprotection in mice. While i.p. injection of $MgCl_2$ (10mg/kg), or PS-K (50mg/kg) or Lentinan (5mg/kg) showed none. The obtained dose reduction factor (DRF) was 1.2 - 1.3. Pretreated mice in which more than 4 or 5 times of hepatic metallothionein (MT) synthesis of the control level was observed showed prominent radioresistance, while pretreated mice in which hepatic MT induction was less than 3 times of the control showed no promotion of radioresistance. The administration of $MnCl_2$, $CdCl_2$, OK432 or Toki as well as skin excision, caused enhancement in superoxide anion production (SOA) in peripheral leukocytes measured by chemiluminescence response, which was due to an increase in the number of polymorphonuclear leukocytes (PMN). The increase in SOA in peripheral leukocytes and hepatic MT synthesis occurred almost concomitantly. The degree of radioresistance was also consistent with peripheral blood corpuscle counts measured on the 10th and 15th postirradiation days. We, therefore, speculate that the enhancement of radioresistance by the preirradiation treatment with a certain metal and/or BRM or stressful load might be established by a coordinating promotion between chemical and immunological protection mechanisms. (author).

22705 (NIRS-M–86, pp. 45-54) **Detection of oncogenes in hamster neoplastic transformants induced by X-rays.** Suzuki, Fumio (Kanazawa Univ. (Japan). Faculty of Pharmaceutical Sciences); Shimizu, Takashi; Nikaido, Osamu. National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Tumor development in vivo has been thought to be a multistep. This hypothesis mainly comes from epidemiological studies on various human tumors. The experimental data for skin carcinogenesis in animal model system has indicated that at least the process can be divided into two steps, initiation and promotion. In vitro transformation in cultured mammalian cells provides an excellent model system for studying the mechanisms of neoplastic development at the cellular level. Using Syrian hamster embryo (SHE) cells, we have examined the expression of transformed phenotypes and analyzed the genetic changes occurred during the process of neoplastic transformation after X-ray irradiation. X-irradiated SHE cells expressed various malignant phenotypes on successive transfer in culture and transformed cell lines isolated at different passages exhibited numerical changes of specific chromosome. Furthermore, the tumorigenic cells obtained at late passages were positive for the ability of their DNA to transform mouse NIH3T3 cells. Recent Southern blot analysis has demonstrated that all primary and secondary transformants contain hamster K-ras genes. Since no point mutation in exon 1, 2 and 3 of K-ras gene was detected in any tumorigenic cell lines, K-ras gene in X-ray-transformed cells may be activated by some other genetic alterations. These results suggest that X-ray-induced neoplastic transformation is a multistep process and that the activation of K-ras gene, in addition to specific chromosome changes, plays an important role in the malignant progression of X-irradiated SHE cells. Here we show some data obtained in spontaneous transformation study and discuss the mechanism of neoplastic development in vitro. (author).

22706 (NIRS-M–86, pp. 55-63) **Cytokine expression induced by ionizing radiation.** Ishihara, Hiroshi (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

It has been reported that several genes are induced by radiation. These genes can be categorized either as 'early-response genes (ERG)' which are inducible just after irradiation or as 'late-response genes (LRG)' which are inducible several hours after irradiation. After irradiation, the ERGs such as protooncogene c-jun are induced via activation of protein kinase C. The gene products stimulate the transcription of the LRGs. The LRG products probably acts for the recovery of damages by radiation. Genes of several cytokines which can be used for the therapy of the damages have been characterized as the LRG. We show that one of the cytokines, interleukin (IL)-1β, was expressed immediately after ionizing radiation both in myeloid leukemic cells and in normal blood cells which are freshly isolated from mice. When radiation was given twice to the cells, the duration of the expression after the second dose was longer than that after the first dose. In this paper, this finding and current studies of the ERGs are summarized and discussed. (author).

22707 (NIRS-M–86, pp. 64-74) **Genetic analysis of resistance to radiation lymphomagenesis and interphase death of thymocytes in mice.** Okumoto, Masaaki (Osaka Prefectural Univ., Sakai (Japan). Research Inst. for Advanced Science and Technology); Mori, Nobuko; Nishikawa, Ryosuke. National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Induction of lymphomas by radiation in mice is controlled by genetic factors. We have analyzed genetic controls of radiation lymphomagenesis and the radiosensitivities for antibody-forming ability and interphase death (apoptosis) of thymocytes in BALB/cHeA, STS/A, crosses and the CXS series of recombinant inbred

strains. Fractionated X-irradiation induced lymphomas at an extremely low incidence in STS/A mice, while it induced the disease at a high incidence in BALB/cHeA mice. The best concordance between strain distribution patterns of genetic markers and resistance to radiation lymphomagenesis in the recombinant inbred strains was observed in a region with the b and Ifa genes on chromosome 4. This indicates that one major locus controlling the resistance is probably located in this region. Decrease in the number of splenic plaque-forming cells (PFC) obtained by Jerne's method after 3 Gy X-irradiation of BALB/cHeA mice was greater by more than one order of magnitude than that of STS/A mice. Results observed in recombinant inbred strains suggest that one locus controlling the radiosensitivity of lymphoid cells for antibody-forming ability exists in the region containing Igh locus on chromosome 12. Thymocytes of BALB/cHeA mice were much more sensitive to induction of interphase death than those of STS/A mice both in vitro and in vivo. In F_1 hybrids, a resistant phenotype similar to STS/A mice appeared dominantly. Segregation pattern in the backcrosses indicated that radiosensitivity of the interphase death of thymocytes was controlled by one major autosomal allele. (author).

22708 (NIRS-M–86, pp. 75-87) **Oncogenes and radiation resistance - a review.** Dritschilo, A. (Georgetown Univ. School of Medicine, Washington, DC (United States)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Oncogenes exert their effects on the genetic programs of cells by regulating signal transduction pathways, resulting in multi-factorial genetic responses. By such actions, the genetic elements responsible for the cellular responses to ionizing radiation may be affected. Reports implicating the association of oncogene expression with modulation of the radiation response include the ras, raf, and myc genes. Experiments overexpressing H-ras and c-raf-1 using genetically engineered constructs result in enhanced post-radiation cellular survival. Conversely, inhibition of raf gene expression has resulted in relative radiation sensitization and delay of human squamous cell carcinoma tumor growth in nude mice. There appears to be a potential strategy for therapeutic intervention. The identification of genes that confer survival advantage following radiation exposure, and understanding their mechanisms of action, may permit a genetically based intervention for radiation sensitization. One such approach employs oligo-deoxynucleotides complementary to oncogene-encoded in RNA's (antisense DNA). (author).

22709 (NIRS-M–86, pp. 92-100) **Biological roles of some recombinant cytokines in radiation-induced myelosuppressive animals.** Tsuboi, Atsushi (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

The recent progress of the protective and the therapeutic effects of γH-IL-1, γH-IL-6 and γH-G-CSF in radiation induced myelosuppressive mice has been summarized. Some of the examined mice were pre-treated with γH-IL-1 with an optimal dose given 4 or 20 hrs before the irradiations. Almost all these mice was rescued from lethal effects after being irradiated with an equal amount of dose which killed 100% of the mice without pre-treatments. The radioprotective dose effects of γH-IL-1 shows the strain dependency of the mice, however, the γH-IL-1 induces some secondary effects, such as high fever. In mice irradiated with sublethal doses, post-treatments of γH-IL-6 accelerates the recovery from radiation damages for hematopoietic stem cells. However, there are no data supporting that γH-IL-6 will enhance the survival of lethally irradiated mice. The post- or pre-treatments with γH-G-CSF accelerates the recovery of radiation damages of hematopoietic stem cells, and the cells in peripheral blood. Post-treatments with γH-G-CSF also enhances the survival of irradiated animals, and no secondary effects has yet been observed. These results indicates that γH-G-CSF is the most promising agent for the therapy of radiation induced myelosuppressive animals or patients. (author).

22710 (NIRS-M–86, pp. 101-109) **Radioprotection by cytokine inducers.** Shikita, Mikiko (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

A group of so-called immunomodulators can provide radioprotection when injected in experimental animals before or after irradiation. The radioprotective effects are attributable probably to the promotion of production of various cytokines in the injected animals. We showed that epigallocatechin galate (EGCG), serum thymic factor (FTS) and a preparation of heat-killed Lactobacillus casei (LC 9018) were all radioprotective. Emphasis has been placed that the administration of large amounts of particular cytokine(s), singly or in combination, must disturb a subtle balance among various cytokines in the body. Endogenous induction of a set of cytokines by such immunomodulators as above may be preferable. (author).

22711 (NIRS-M–86, pp. 153-158) **Radiation hormesis: The stimulatory effects of low level ionizing radiation.** Yamada, Takeshi (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

'Hormesis' is the name given to the stimulating effect of small doses of substances which in larger doses are inhibitory. The term needs not be limited to stimulation but may well be applied to any physiological effect which occurs at low doses and which cannot be anticipated by extrapolating from toxic effects noted at high doses. Radiation hormesis is, therefore, could be defined as biopositive effects of low dose radiation, which could not be assumed from the detrimental effects of radiation at high doses. This review summarizes some of the relevant historical and scientific concepts bearing on the question of radiation hormesis. (author).

22712 (NIRS-M–86, pp. 159-170) **Induced accumulation of polyubiquitin gene transcripts in HeLa cells after UV-irradiation or TPA-treatment.** Nenoi, Mitsuru (National Inst. of Radiological Sciences, Chiba (Japan)); Mita, Kazuei; Ichimura, Sachiko. National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

There are three species of ubiquitin gene transcripts in HeLa cells, termed UbA (≈ 0.65 kb), UbB (≈ 1.1 kb) and UbC (≈ 2.5 kb). In the present report, the UbC transcript was shown to be induced up to 2.5-fold after irradiation with UV light or treatment with phorbol ester (TPA). The kinetic analysis indicated the induction of the UbC gene was rapid and transient, as the maximal accumulation of the UbC transcript was induced at 2.5 h after UV irradiation or 3 h after TPA treatment. On the other hand, induction of UbA and UbB, in almost cases, was not observed. (author).

22713 (NIRS-M–86, pp. 171-176) **DNA repair mechanism in radioresistant bacteria.** Kitayama, Shigeru (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Many radiation resistant bacteria have been isolated from various sources which are not in high background field. Since Deinococcus radiodurans had been isolated first in 1956, the studies on the mechanism of radioresistance were mostly carried out using this bacterium. DNA in this bacterium isn't protected against injury induced by not only ionizing radiation but also ultraviolet light. Therefore, DNA damages induced by various treatments are efficiently and accurately repaired in this cells. Damages in base and/or sugar in DNA are removed by endonucleases which, if not

all, are synthesized during postirradiation incubation. Following the endonucleolytic cleavage the strand scissions in DNA are seemed to be rejoined by a process common for the repair of strand scissions induced by such as ionizing radiations. Induce protein(s) is also involved in this rejoining process of strand scissions. DNA repair genes were classified into three phenotypic groups. (1) Genes which are responsible for the endonucleolytic activities. (2) Genes involved in the rejoining of DNA strand scissions. (3) Genes which participate in genetic recombination and repair. Three genes belong to (1) and (2) were cloned onto approximately 1 kbp DNA fragments which base sequences have been determined. (author).

22714 (NIRS-M–86, pp. 177-188) **Adaptive response to low doses of ionizing radiation.** Ikushima, Takaji (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

An adaptive response to radiation stress was found in cultured Chinese hamster V79 cells, as a suppressed induction of micronuclei and sister chromatid exchanges in the cells conditioned by very low doses. The important characteristics of the novel chromosomal response, called radio-adaptive response (RAR), that have emerged in a series of experiments are: 1. A narrow window of low doses (cGy level of an optimal dose range) of beta-rays from tritiated thymidine and from tritiated water causes RAR. 2. Gamma-rays act as tritium beta-rays. 3. Thermal neutrons, a high LET radiation, can not act as tritium beta-rays or gamma-rays. 4. A 4-h interval is required for full expression of RAR, which decays with the progression of cell proliferation. 5. The RAR expression is suppressed by treatments with inhibitors of poly(ADP-ribose) polymerase and protein synthesis. 6. The RAR can affect clastogenic lesions induced by other physical and chemical DNA damaging agents. 7. Several proteins are newly synthesized concurrently with the RAR expression after adapting doses, viewed by two-dimensional electrophoresis of cellular proteins. These results suggest that the RAR is an adaptive chromosomal DNA repair mechanism induced by very low doses of low LET radiations under restricted conditions, accompanying the inducible specific gene expression. (author).

22715 (NIRS-M–86, pp. 192-203) **Influence of endocrinological status at exposure on radiation-induced mammary tumorigenesis of rats.** Inano, Hiroshi (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

Epidemiologic observations indicate that increased mammary cancer risk in human female is associated with nulliparity, increased age at first full-term pregnancy and abortion, and that mammary gland seems to be also more sensitive to ionizing radiation by absolute risk/rad of atomic-bomb survivors in Hiroshima and Nagasaki. The present paper has reviewed to determine the relationship between hormonal and receptor levels and tumorigenesis of mammary gland by radiation. When Wistar rats received whole body irradiation with 260 cGy gamma-rays, low incidence for tumorigenesis of mammary glands was observed. From the results of radiation-induced mammary tumorigenesis in the estrous cycle at exposure, the highest incidence arose in rats by irradiation on diestrus in minimum level of ovarian hormones and prolactin in serum. Also, the irradiation in late pregnancy clearly facilitated the occurrence of mammary tumors whereas treatment in early- and mid-pregnancy suppressed the cumulative incidence. The concentrations of estradiol and progesterone in serum and estrogen receptor in mammary glands were gradually increased during late pregnancy. High incidence was also indicated in rats which were irradiated in lactating period. Function of well-differentiated mammary glands of lactating rats was mainly regulated by prolactin. Pregnant rats were exposed to gamma-rays with treatment by radioprotective chemicals, cysteamine and WR-2721 before irradiation. The incidence of mammary tumorigenesis was not affected by the radical scavengers. A mechanism of radiation-induced tumorigenesis of mammary glands is suggested to differ from that of carcinogenesis of rats exposed to DMBA. These data indicate that ionizing radiation can act as a strong initiator in rat mammary glands differentiated by ovarian steroid hormones. (J.P.N.).

22716 (NIRS-M–86, pp. 204-212) **Host factors influencing for the development of radiation induced hepatic tumors in mice.** Ito, Akihiro (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology). National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

To determine the relative biological effectiveness (RBE) of Cf-252 fission neutrons versus Co-60 gamma rays for inducing liver tumorigenesis, BCF_1 mice were irradiated once either with Cf-252 or Co-60 and the tumorigenicity of the two types of radiation was compared. Individual groups of BCF_1 mice were irradiated once with Cf-252 at doses between 0 and 200 cGy for both sexes of mice, or with Co-60 at the same doses for both sexes. The groups of mice were observed for 13 months after irradiation. The incidence of hepatic tumors in non-irradiated controls was 3.8% in males and 3.2% in females. Cf-252 irradiation increased the tumor incidence dose dependently in males and females. RBE of Cf-252 compared to Co-60 was quite high in the low dose range. Overall, the average RBE of Cf-252 versus Co-60 was 15.2 in males and 2.5 in females. The strain difference of hepatic tumors was also studied in both sexes of C3H, BCF_1, CBF_1 and C57BL mice by irradiating 0 to 200 cGy of Cf-252. Tumor incidence, multiplicity and size of them were highest in C3H, lowest in C57BL and in between in BCF_1 and CBF_1 mice, and it was always higher in males than that in females. In another experiment, 7-week-old male C3H mice were irradiated with 0, 50, and 200 cGy of Cf-252, and 2 weeks later they were mated with nonirradiated C57BL female mice. The incidence of hepatic tumors in the offspring of irradiated fathers was 43% in males and 1.7% in females, whereas in the offspring of control mice with non-irradiated fathers the incidence was 3.2% in males and 3.3% in females. These results indicated a strong hepatocarcinogenic potential for Cf-252 neutrons compared to Co-60 gamma rays, and that the cancer-prone genetic trait activated by Cf-252 irradiation was inherited by first-generation offspring, especially in males. (J.P.N.).

22717 (NIRS-M–86, pp. 213-222) **Strategy of research for cancer-chemoprevention.** Ito, Nobuyuki (Nagoya City Univ. (Japan). Faculty of Medicine); Imaida, Katsumi; Hirose, Masao; Hasegawa, Ryohei; Shirai, Tomoyuki. National Inst. of Radiological Sciences, Chiba (Japan). May 1992. (In Japanese). (CONF-9112180–: 23. NIRS symposium, Chiba (Japan), 5-6 Dec 1991). In *Induction of radiation resistance: Biological and chemical means for radioprotection.* 240p. Order Number DE94753219. Source: OSTI; NTIS; INIS.

It has been reported that environmental chemicals are important factors in terms of both development and prevention of human cancer. For prevention of human cancer, detection of early cancer and clinical trials at the early stage have been focused so far. Now, next main project will be investigation for prevention of cancer development itself. Chemoprevention of carcinogenesis, which means prevention of carcinogenesis by some chemical compounds, have been investigated extensively in a variety of organs, but in only one organ. However, from results of our studies, antioxidants such as BHA, responded differently to organs, and whole body investigation, not only one organ carcinogenesis, should be performed to investigate of chemoprevention. Furthermore, the mechanisms of action of chemoprevention and on which step of carcinogenesis does the chemopreventive compound prevent, such as initiation, promotion, progression or whole carcinogenesis steps should be discussed. We have developed a medium term bioassay system and multi-organ carcinogenesis system, which can be used for investigation of cancer chemoprevention. Using these systems, we have investigated dose response inhibitory effects of BHA and

α-tocopherol by the medium-term bioassay system, and catechins in the green tea inhibit small intestinal carcinogenesis in the multi-organ carcinogenesis. It is important for prevent human cancer to find other candidates for chemopreventive agents using animal study. (author).

22718 (NUREG/GR–0011) **Information bias and lifetime mortality risks of radiation-induced cancer: Low LET radiation.** Peterson, L.E. (Texas Univ., Houston, TX (United States). Health Science Center); Schull, W.J.; Davis, B.R.; Buffler, P.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Texas Univ., Houston, TX (United States). Health Science Center; California Univ., Berkeley, CA (United States). School of Public Health. Apr 1994. 166p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Additive and multiplicative models of relative risk were used to measure the effect of cancer misclassification and DS86 random errors on lifetime risk projections in the Life Span Study (LSS) of Hiroshima and Nagasaki atomic bomb survivors. The true number of cancer deaths in each stratum of the cancer mortality cross-classification was estimated using sufficient statistics from the EM algorithm. Average survivor doses in the strata were corrected for DS86 random error (σ=0.45) by use of reduction factors. Poisson regression was used to model the corrected and uncorrected mortality rates with risks in RERF Report 11 (Part 2) and the BEIR-V Report. Bias due to DS86 random error typically ranged from −15% to −30% for both sexes, and all sites and models. The total bias, including diagnostic misclassification, of excess risk of non-leukemia for exposure to 1 Sv from age 18 to 65 under the non-constant relative project model was −37.1% for males and −23.3% for females. Total excess risks of leukemia under the relative projection model were biased −27.1% for males and −43.4% for females. Thus, nonleukemia risks for 1 Sv from ages 18 to 65 (DRREF=2) increased from 1.91%/Sv to 2.68%/Sv among males and from 3.23%/Sv to 4.92%/Sv among females. Leukemia excess risk increased from 0.87%/Sv to 1.10/Sv among males and from 0.73%/Sv to 1.04/Sv among females. Bias was dependent on the gender, site, correction method, exposure profile and projection model considered. Future studies that use LSS data for US nuclear workers may be downwardly biased if lifetime risk projections are not adjusted for random and systematic errors.

22719 (PNL–9467) **U.S. Department of Energy Workers' mental models of radiation and chemical hazards in the workplace.** Quadrel, M.J.; Blanchard, K.A.; Lundgren, R.E.; McMakin, A.H.; Mosley, M.T.; Strom, D.J. Battelle Pacific Northwest Lab., Richland, WA (United States). May 1994. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012413. Source: OSTI; NTIS; INIS; GPO Dep.

A pilot study was performed to test the mental models methodology regarding knowledge and perceptions of U.S. Department of Energy contractor radiation workers about ionizing radiation and hazardous chemicals. The mental models methodology establishes a target population's beliefs about risks and compares them with current scientific knowledge. The ultimate intent is to develop risk communication guidelines that address information gaps or misperceptions that could affect decisions and behavior. In this study, 15 radiation workers from the Hanford Site in Washington State were interviewed about radiation exposure processes and effects. Their beliefs were mapped onto a science model of the same topics to see where differences occurred. In general, workers' mental models covered many of the high-level parts of the science model but did not have the same level of detail. The following concepts appeared to be well understood by most interviewees: types, form, and properties of workplace radiation; administrative and physical controls to reduce radiation exposure risk; and the relationship of dose and effects. However, several concepts were rarely mentioned by most interviewees, indicating potential gaps in worker understanding. Most workers did not discuss the wide range of measures for neutralizing or decontaminating individuals following internal contamination. Few noted specific ways of measuring dose or factors that affect dose. Few mentioned the range of possible effects, including genetic effects, birth defects, or high dose effects. Variables that influence potential effects were rarely discussed. Workers rarely mentioned how basic radiation principles influenced the source, type, or mitigation of radiation risk in the workplace.

22720 (PNL-SA–23309) **Effects of inhaled plutonium nitrate on bone and liver in dogs.** Dagle, G.E. (Pacific Northwest Lab., Richland, WA (United States). Biology and Chemistry Dept.); Weller, R.E.; Watson, C.R.; Buschbom, R.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-940437–5: International seminar on health effects of radium and thorium, Heidelberg (Germany), 18-22 Apr 1994). Order Number DE94013326. Source: OSTI; NTIS; INIS; GPO Dep.

The life-span biological effects of inhaled soluble, alpha-emitting radionuclides deposited in the skeleton and liver were studied in 5 groups of 20 beagles exposed to initial lung depositions ranging from 0.48 to 518 Bq/g of lung. Average plutonium amounts in the lungs decreased to approximately 1% of the final body deposition in dogs surviving 5 years or more; more than 90% of the final depositions accumulated in the liver and skeleton. The liver-to-skeletal ratio of deposited plutonium was 0.83. The incidence of bone tumors, primarily osteogenic sarcomas causing early mortality, at final group average skeletal depositions of 15.8, 2.1, and 0.5 Bq/g was, respectively, 85%, 50%, and 5%; there were no bone tumors in exposure groups with mean average depositions lower than 0.5 Bq/g. Elevated serum liver enzyme levels were observed in exposure groups down to 1.3 Bq/g. The incidence of liver tumors at final group average liver depositions of 6.9, 1.3, 0.2, and 0.1 Bq/g, was, respectively, 25%, 15%, 15%, and 15%; one hepatoma occurred among 40 control dogs. The risk of the liver cancer produced by inhaled plutonium nitrate was difficult to assess due to the competing risks of life shortening from lung and bone tumors.

22721 (PNWD–2023-HEDR-Rev.1) **Parameters used in the environmental pathways and radiological dose modules (DESCARTES, CIDER, and CRD codes) of the Hanford Environmental Dose Reconstruction Integrated Codes (HEDRIC).** Snyder, S.F.; Farris, W.T.; Napier, B.A.; Ikenberry, T.A.; Gilbert, R.O. Pacific Northwest Lab., Richland, WA (United States). May 1994. 234p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94013197. Source: OSTI; NTIS; INIS; GPO Dep.

This letter report is a description of work performed for the Hanford Environmental Dose Reconstruction (HEDR) Project. The HEDR Project was established to estimate the radiation doses to individuals resulting from releases of radionuclides from the Hanford Site during the period of 1944 to 1992. This work is being done by staff at Battelle, Pacific Northwest Laboratories under a contract with the Centers for Disease Control and Prevention with technical direction provided by an independent Technical Steering Panel (TSP).

22722 (PNWD–2221-HEDR) **Validation of HEDR models: Hanford Environmental Dose Reconstruction Project.** Napier, B.A.; Simpson, J.C.; Eslinger, P.W.; Ramsdell, J.V. Jr.; Thiede, M.E.; Walters, W.H. Pacific Northwest Lab., Richland, WA (United States). May 1994. 192p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE94013712. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Environmental Dose Reconstruction (HEDR) Project has developed a set of computer models for estimating the possible radiation doses that individuals may have received from past Hanford Site operations. This document describes the validation of these models. In the HEDR Project, the model validation exercise consisted of comparing computational model estimates with limited historical field measurements and experimental measurements that are independent of those used to develop the models. The results of any one test do not mean that a model is valid. Rather, the collection of tests together provide a level of confidence that the HEDR models are valid.

22723 (PNWD–2222-HEDR) **Radionuclide releases to the atmosphere from Hanford Operations, 1944–1972: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Pacific Northwest Lab., Richland, WA (United States). May 1994. 203p. Sponsored by Department of Health and Human Services, Washington, DC (United States). Order Number DE94013713. Source: OSTI; NTIS; INIS.

The purpose of the Hanford Environmental Dose Reconstruction Project is to estimate the radiation dose that individuals could have received as a result of radionuclide emissions since 1944 from the Hanford Site. The first step in determining dose is to estimate the amount and timing of radionuclide releases to air and water. This report provides the air release information.

22724 (PNWD–2225-HEDR) **Reconstruction of radionuclide concentrations in the Columbia River from Hanford, Washington to Portland, Oregon, January 1950–January 1971: Hanford Environmental Dose Reconstruction Project.** Walters, W.H. (Pacific Northwest Lab., Richland, WA (United States)); Gilmore, B.G.; Richmond, M.C. Pacific Northwest Lab., Richland, WA (United States). May 1994. 158p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-053 Contract 18620. Order Number DE94013746. Source: OSTI; NTIS; INIS; GPO Dep.

Battelle, Pacific Northwest Laboratories conducted this study of the Columbia River for the Technical Steering Panel (TSP) and the Centers for Disease Control and Prevention as part of the Hanford Environmental Dose Reconstruction (HEDR) Project. The HEDR Project was established to estimate the radiation dose that individuals may have received from operations that began at the Hanford Site in 1944. The purpose of the study was to reconstruct concentrations of radionuclides in Columbia River water for estimating doses to humans from the river pathway.

22725 (PNWD–2234-HEDR) **Environmental radiological monitoring of air, rain, and snow on and near the Hanford Site, 1945-1957.** Hanf, R.W.; Thiede, M.E. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 127p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012246. Source: OSTI; NTIS; GPO Dep.

This report is a result of the Hanford Environmental Dose Reconstruction (HEDR) Project. The goal of the HEDR Project is to estimate the radiation dose that individuals could have received from emissions since 1944 at the Hanford Site near Richland, Washington. Members of the HEDR Project's Environmental Monitoring Data Task have developed databases of historical environmental measurements of such emissions. Hanford documents were searched for information on the radiological monitoring of air, rain, and snow at and near the Hanford Site in Richland, Washington. The monitoring information was reviewed and summarized. The end product is a yearly overview of air, rain, and snow samples as well as ambient radiation levels in the air that were measured from 1945 through 1957. The following information is provided in each annual summary: the media sampled, the constituents (radionuclides) measured/reported, the sampling locations, the sampling frequencies, the sampling methods, and the document references. For some years a notes category is included that contains additional useful information. For the years 1948 through 1957, tables summarizing the sampling locations for the various sample media are also included in the appendix. A large number of documents were reviewed to obtain the information in this report. A reference list is attached to the end of each annual summary. All of the information summarized here was obtained from reports originating at Hanford. These reports are all publicly available and can be found in the Richland Operations Office (RL) public reading room. The information in this report has been compiled without analysis and should only be used as a guide to the original documents.

22726 (PNWD–2235-HEDR) **Overview of vegetation monitoring data, 1952–1983: Hanford Environmental Dose Reconstruction Project.** Duncan, J.P. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 202p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012247. Source: OSTI; NTIS; GPO Dep.

Contains 2 diskettes.

This report is a result of the Hanford Environmental Dose Reconstruction (HEDR) Project. The goal of the HEDR Project is to estimate the radiation dose that individuals could have received from emissions since 1944 at the Hanford Site near Richland, Washington. Members of the HEDR Project's Environmental Monitoring Data Task have developed databases of historical environmental measurements of such emissions. The HEDR Project is conducted by Battelle, Pacific Northwest Laboratories. This report is the third in a series that documents the information available on measurements of iodine-131 concentrations in vegetation. The first two reports provide the data for 1945–1951. This report provides an overview of the historical documents, which contain vegetation data for 1952–1983. The overview is organized according to the documents available for any given year. Each section, covering one year, contains a discussion of the media sampled, the sampling locations, significant events if there were any, emission quantities, constituents measured, and a list of the documents with complete reference information. Because the emissions which affected vegetation were significantly less after 1951, the vegetation monitoring data after that date have not been used in the HEDR Project. However, access to these data may be of interest to the public. This overview is, therefore, being published.

22727 (UCRL-JC–117173) **Model calculations of nuclear data for biologically-important elements.** Chadwick, M.B. (Lawrence Livermore National Lab., CA (United States)); Blann, M.; Reffo, G.; Young, P.G. Lawrence Livermore National Lab., CA (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940507–10: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012675. Source: OSTI; NTIS; INIS; GPO Dep.

We describe calculations of neutron-induced reactions on carbon and oxygen for incident energies up to 70 MeV, the relevant clinical energy in radiation neutron therapy. Our calculations using the FKK-GNASH, GNASH, and ALICE codes are compared with experimental measurements, and their usefulness for modeling reactions on biologically-important elements is assessed.

22728 (WHC-EP–0750-Vol.4) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 4.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 278p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012302. Source: OSTI; NTIS; INIS; GPO Dep.

Radiation protection of personnel and the public is accomplished by establishing a well defined Radiation Protection Organization to ensure that appropriate controls on radioactive materials and radiation sources are implemented and documented. This Requirements Identification Document (RID) applies to the activities, personnel, structures, systems, components, and programs involved in executing the mission of the Tank Farms. The physical boundaries within which the requirements of this RID apply are the Single Shell Tank Farms, Double Shell Tank Farms, 242-A Evaporator-Crystallizer, 242-S, T Evaporators, Liquid Effluent Retention Facility (LERF), Purgewater Storage Facility (PWSF), and all interconnecting piping, valves, instrumentation, and controls. Also included is all piping, valves, instrumentation, and controls up to and including the most remote valve under Tank Farms control at any other Hanford Facility having an interconnection with Tank Farms. The boundary of the structures, systems, components, and programs to which this RID applies, is defined by those that are dedicated to and/or under the control of the Tank Farms Operations Department and are specifically implemented at the Tank Farms.

22729 (WHC-EP–0750-Vol.7) **High-level waste storage tank farms/242-A evaporator standards/requirements identification document (S/RID), Vol. 7.** Westinghouse Hanford Co., Richland, WA (United States). Apr 1994. 225p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE94012305. Source: OSTI; NTIS; INIS; GPO Dep.

This Requirements Identification Document (RID) describes an Occupational Health and Safety Program as defined through the Relevant DOE Orders, regulations, industry codes/standards, industry guidance documents and, as appropriate, good industry

practice. The definition of an Occupational Health and Safety Program as specified by this document is intended to address Defense Nuclear Facilities Safety Board Recommendations 90-2 and 91-1, which call for the strengthening of DOE complex activities through the identification and application of relevant standards which supplement or exceed requirements mandated by DOE Orders. This RID applies to the activities, personnel, structures, systems, components, and programs involved in maintaining the facility and executing the mission of the High-Level Waste Storage Tank Farms.

22730 (WSRC-TR–94-053) **MAXINE: An improved methodology for estimating maximum individual dose from chronic atmospheric radioactive releases.** Hamby, D.M. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Feb 1994. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013207. Source: OSTI; NTIS; INIS; GPO Dep.

An EXCEL® spreadsheet has been developed that, when combined with the PC version of XOQDOQ, will generate estimates of maximum individual dose from routine atmospheric releases of radionuclides. The spreadsheet, MAXINE, utilizes a variety of atmospheric dispersion factors to calculate radiation dose as recommended by the US Nuclear Regulatory Commission in Regulatory Guide 1.109 [USNRC 1977a]. The methodology suggested herein includes use of both the MAXINE spreadsheet and the PC version of XOQDOQ.

5602 Thermal Effects

Refer also to citation(s) 21761, 21762

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 21052, 21153, 21759, 21760, 21763, 21765, 21766, 21767, 21768, 21769, 21770, 21771, 22164, 22490, 22513, 22613

22731 (CONF-940301–35) **Use of bioassays in assessing health hazards from complex mixtures: A RASH analysis.** Jones, T.D. Oak Ridge National Lab., TN (United States). 14 Oct 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 207. spring national meeting of the American Chemical Society (ACS); San Diego, CA (United States); 13-18 Mar 1994. Order Number DE94012733. Source: OSTI; NTIS; GPO Dep.

The Finney harmonic mean model for joint toxicity of ingredients in mixtures can be used to estimate the toxicity of the neat compound if one component can be substituted in potency-adjusted-doses for each of the other components. Chemical analysis data and relative potency values (computed according to the Rapid Screening of Hazard (RASH) method) were used to compare the toxicities as predicted from ingredients of cigarette smoke, PAHs in diesel exhaust, asphalt, coal tar, pitch, and creosote with the measured toxicities of the neat mixtures. Accuracy for cigarette smoke condensate, coal tar, pitch, and creosote were within a factor of three; asphalt within a factor of 18; but the PAC content of diesel particulate was inadequate to accurately describe the toxicity of diesel emissions.

22732 (DOE/ER/60490–T2) **Response of plants and ecosystems to CO_2 and climate change: Final technical report.** Reynolds, J.F. San Diego State Univ., CA (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER60490. Order Number DE94011583. Source: OSTI; NTIS; GPO Dep.

In recognition of the important role of vegetation in the biogeosphere carbon cycle, the Carbon Dioxide Research Program of the US Department of Energy established the research program: Direct Effects of increasing Carbon Dioxide on Vegetation. The ultimate goal is to develop a general ecosystem model to investigate, via hypothesis testing, the potential responses of different terrestrial ecosystems to changes in the global environment over the next century. The approach involves the parallel development of models at several hierarchical levels, from the leaf to the ecosystem. At the plant level, mechanism and the direct effects of CO_2 in the development of a general plant growth model, GEPSI - GEneral Plant SImulator has been stressed. At the ecosystem level, we have stressed the translation Of CO_2 effects and other aspects of climate change throughout the ecosystem, including feedbacks and constraints to system response, in the development of a mechanistic, general ecosystem model SERECO - Simulation of Ecosystem Response to Elevated CO_2 and Climate Change has been stressed.

22733 (DOE/MC/26018–3737) **Mutagenicity of diesel exhaust soot dispersed in phospholipid surfactants.** Wallace, W.; Keane, M.; Xing, S.; Harrison, J.; Gautam, M.; Ong, T. National Inst. for Occupational Safety and Health, Morgantown, WV (United States). Div. of Respiratory Disease Studies. [1994]. 5p. Sponsored by USDOE, Washington, DC (United States);Department of the Interior, Washington, DC (United States). DOE Contract AI21-89MC26018. Order Number DE94012518. Source: OSTI; NTIS; GPO Dep.

Organics extractable from respirable diesel exhaust soot particles by organic solvents have been known for some time to be direct acting frameshift mutagens in the Ames Salmonella typhimurium histidine reversion assay. Upon deposition in a pulmonary alveolus or respiratory bronchiole, respirable diesel soot particles will contact first the hypophase which is coated by and laden with surfactants. To model interactions of soot and pulmonary surfactant, the authors dispersed soots in vitro in the primary phospholipid pulmonary surfactant dipalmitoyl glycerophosphorylcholine (lecithin) (DPL) in physiological saline. They have shown that diesel soots dispersed in lecithin surfactant can express mutagenic activity, in the Ames assay system using S. typhimurium TA98, comparable to that expressed by equal amounts of soot extracted by dichloromethane/dimethylsulfoxide (DCM/DMSO). Here the authors report additional data on the same system using additional exhaust soots and also using two other phospholipids, dipalmitoyl glycerophosphoryl ethanolamine (DPPE), and dipalmitoyl phosphatidic acid (DPPA), with different ionic character hydrophilic moieties. A preliminary study of the surfactant dispersed soot in an eucaryotic cell test system also is reported.

22734 (GSF–3/93) **Quantitative assessment of exposure and risk for three carcinogenics in long-standing pollution sites.** Wichmann, H.E. (GSF - Forschungszentrum fuer Umwelt und Gesundheit Neuherberg GmbH, Oberschleissheim (Germany). Inst. fuer Epidemiologie); Ihme, W. GSF - Forschungszentrum fuer Umwelt und Gesundheit Neuherberg GmbH, Oberschleissheim (Germany). 1993. 147p. (In German). Sponsored by Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Order Number DE94774277. Source: OSTI; NTIS (US Sales Only); INIS.

The project attempts a quantitative assessment of risks for three carcinogenics that are common in sites of long-standing pollution. Benzo(a)pyrene stands for the group of polycyclic aromatic hydrocarbons, cadmium for heavy metals, and benzene for volatile aromatic compounds. The report discusses the general fundamentals of exposure and risk assessment. The exposure model is described in detail and applied to the three test substances. (orig./MG)

22735 (Juel–2805) **Environmental relevance of correlations of $\delta^{13}C$ and climate in tree rings of young pines (Pinus silvestris L.).** Hemmann, A.G. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie und Dynamik der Geosphaere 4: Erdoel und Organische Chemie; Koeln Univ. (Germany). Aug 1993. 108p. (In German). Order Number DE94774161. Source: OSTI; NTIS (US Sales Only); INIS.

From two groups of trees, 15 damaged ones and 15 healthy ones, tree slices were taken and in these the tree-ring widths, ratios of $\delta^{13}C$ isotopes in cellulose and trace element concentrations were determined. Healthy trees have wider tree-rings over their entire period of life from 1891 to 1986 than the group of trees of damage category 3 (severely damaged). The pattern of tree-ring width development, however, is similar. From eight synchronous $\delta^{13}C$ traces of non-damaged pines a normal chronology was derived. The ontogenesis of some damaged individuals does not correspond to this normal course. In this way the onset of damage can be reconstructed by means of the $\delta^{13}C$ values. A link between

the $\delta^{13}C$ values curves and anthropogenously induced changes of atmospheric CO_2 concentration could not be established. The yearly variations of the $\delta^{13}C$ values of the normal chronology are climate-sensitive. The established trace element concentrations of the wood samples are neither in the toxic nor in the deficiency range. Their magnitude is abour equal in all radial sections, independently of the damage category. (UWA)

22736 (KFK-PEF–106) **The dependence of natural regeneration of forest trees on upper soil conditions and acidity at damaged sites in the Black Forest, Germany.** Littek, T. (Freiburg Univ. (Germany). Waldbau-Institut). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Jun 1993. 284p. (In German). Sponsored by Land Baden-Wuerttemberg, Stuttgart (Germany);Commission of the European Communities, Brussels (Belgium). Contract PEF 87/007/1A. Order Number DE94774211. Source: OSTI; NTIS (US Sales Only); INIS.

It was the goal of this study to investigate the influence of different upper soil conditions on the germination and establishment, as well as the growth, of young plants of various tree species. For this purpose, four test plots in the region of the Black Forest were laid out, in which, by various means of site preparation and fertilization, the upper soils were changed. Natural seeding of common spruce, European silver-fir, beech, sycamore maple, European mountainash, and grey alder was simulated by means of controlled sowing. For comparison, a greenhouse experiment was carried out, examining the germination and development of the same tree species in various soil substrata, using different fertilizers, and under the influence of artificial acid rain. The most important results - with a high level of variation depending on the tree species examined - can be summarized as follows: Based on the results of field and greenhouse experiments, as well as on the investigations of other authors, it can be concluded that natural regeneration of forest stands is considerably impeded under conditions of increasing soil acidity and by high acid depositions. This is seen directly as the result of unfavorable chemical conditions in the upper soil, as well as indirectly due to deteriorating competitiveness against other vegetation. Site preparation and lime or dolomite fertilization can be important measures in the practice of forestry, to encourage natural regeneration in highly acidic sites with an unfavourable humus layer and a high presence of competing vegetation. (orig./UWA). 2 figs., 85 tabs., 269 refs.

22737 (KFK-PEF–108) **Genetic structures of forest trees with different levels of damage on permanent observation plots on forest decline in Baden-Wuerttemberg.** Loechelt, S. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany)); Franke, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Jul 1993. 124p. (In German). Sponsored by Land Baden-Wuerttemberg, Stuttgart (Germany);Commission of the European Communities, Brussels (Belgium). Contract PEF 89/003/1A. Order Number DE94774210. Source: OSTI; NTIS (US Sales Only); INIS.

The genetic structures of forest trees (Picea abies (L.) Karst., Abies alba Mill., Quercus petraea (Matt.) Liebl., Quercus robur L.) with different levels of damage, growing on permanent observation plots of forest decline in Baden-Wuerttemberg, were studied by isoenzyme analysis. In order to prove supposed interactions between the genetic structures and the level of damage, statistical methods were used. Statistically significant differences were detected between the genetic structure of 'tolerant' and 'sensitive' tree subpopulations, whereas these deviations had not the same tendency for all stands. For the first time the genetic variation within and between populations of Quercus robur and Quercus petraea in Baden-Wuerttemberg was described. Similar examinations on firs which had been published in 1992 are summarized briefly. (orig./UWA). 13 figs., 25 tabs., 84 refs.

22738 (PNL–7458) **Inhalation developmental toxicology studies: Developmental toxicity of chloroprene vapors in New Zealand white rabbits: Final report.** Mast, T.J.; Evanoff, J.J.; Westerberg, R.B.; Rommereim, R.L.; Weigel, R.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 237p. Sponsored by National Insts. of Health, Bethesda, MD (United States). DOE Contract AC06-76RL01830. Order Number DE94012384. Source: OSTI; NTIS; GPO Dep.

Chloroprene, 2-chloro-1,3-butadiene, is a colorless liquid with a pungent ethereal odor that is primarily used as an intermediate in the manufacture of neoprene rubber, and has been used as such since about 1930. This study addressed the potential for chloroprene to cause developmental toxicity in New Zealand white rabbits following gestational exposure to 0, 10, 40, or 175 ppm chloroprene vapors, 6h/dy, 7dy/wk. Each treatment group consisted of 15 artificially inseminated females exposed on 6 through 28 days of gestation (dg). Body weights were obtained throughout the study period, and uterine and fetal body weights were obtained at sacrifice on 29 dg. Implants were enumerated and their status recorded and live fetuses were examined for gross, visceral, skeletal, and soft-tissue craniofacial defects. There were no overt signs of maternal toxicity and the change in maternal body weight over the course of the study was not affected. Exposure of pregnant rabbits to chloroprene vapors on 6-28 dg had no effect on the number of implantation, the mean percent of live pups per litter, or on the incidence of resorptions per litter. The incidence of fetal malformations was not increased by exposure to chloroprene. Results of this study indicate that gestational exposure of New Zealand white rabbits to 10, 40, or 175 ppm chloroprene did not result in observable toxicity to either the dam or the offspring.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 21179

22739 (ANL/EA/CP–82333) **Comparative review of available computer programs for modeling meteorological and terrain effects on long-range propagation of audible noise.** Liebich, R.E. (Raytheon Environmental Services, Philadelphia, PA (United States)); Chun, Kyong C. Argonne National Lab., IL (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940632–13: Annual meeting and exhibition of the Air and Waste Management Association, Cincinnati, OH (United States), 19-24 Jun 1994). Order Number DE94012458. Source: OSTI; NTIS; GPO Dep.

Assessment of the environmental impacts of audible noise produced by human activities – such as construction and operation of industrial facilities, vehicular traffic, and aircraft operations – requires the use of sound-propagation computer programs capable of predicting the sound-pressure spectra that will be produced by these noise sources at distances as great as 10 km. Under acoustically unfavorable meteorological conditions, such as ground-based temperature inversions and noise-sensitive receptors being located downwind from intrusive sound sources, audible noise levels can be increased, even on the order of 20 dB. This paper presents a brief overview of computer programs currently available ("operational") for predicting the effects of such meteorological conditions on audible noise levels in a format that allows gross comparison of the relative capabilities of the programs from the standpoint of engineering application to environmental impact assessment.

22740 (DOE/ER/61563–1) **BEMS: Abstract book, fifteenth annual meeting.** Wisecup, W.G. Bioelectromagnetics Society, Frederick, MD (United States). [1993]. 175p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-93ER61563. (CONF-9306340–Absts.: 15. Bioelectromagnetics Society (BEMS) conference, Los Angeles, CA (United States), 13-17 Jun 1993). Order Number DE94013787. Source: OSTI; NTIS; INIS; GPO Dep.

This volume provides abstracts of presentations made at the Fifteenth Annual Meeting of the Bioelectromagnetics Society held in Los Angeles, California June 13–17, 1993.

22741 (ENEA-RT-GEN–91-03) **Noise pollution measurement and evaluation in some ENEA Montecuccolino Center working areas.** Speranza, A. (ENEA, Bologna (Italy)). ENEA, Bologna (Italy). Mar 1993. 36p. (In Italian). (RT/GEN–92-03). Order Number DE94775297. Source: OSTI; NTIS (US Sales Only).

Noise in working environments is considered as one of the most widespread professional risks. Although noise related effects alone account about for 60 per cent of workers' compensation paid out

every year in Italy, usually it is hardly taken into account in the working places observed for research purposes. This paper presents the results of noise level analyses concerning the surveys carried out in some Montecuccolino CRE-ENEA (Italian National Agency for Energy, New Technologies and the Environment) working environments.

57 HEALTH AND SAFETY

Refer also to citation(s) 21098, 22718

22742 (MSHA/IR–1217) **Injury experience in sand and gravel mining, 1992.** Reich, R.B.; Hugler, E.C. Mine Safety and Health Administration, Denver, CO (United States). Safety and Health Technology Center. 1994. 107p. Sponsored by Department of Labor, Washington, DC (United States). Order Number DE94011057. Source: OSTI; NTIS.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of sand and gravel mining in the United States for 1992. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, and occupation. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report.

22743 (MSHA/IR–1218) **Injury experience in metallic mineral mining, 1992.** Mine Safety and Health Administration, Denver, CO (United States). Safety and Health Technology Center. 1994. 276p. Sponsored by Department of Labor, Washington, DC (United States). Order Number DE94011058. Source: OSTI; NTIS.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of metallic mineral mining in the United States for 1992. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report.

22744 (MSHA/IR–1219) **Injury experience in nonmetallic mineral mining (except stone and coal), 1992.** Reich, R.B; Hugler, E.C. Mine Safety and Health Administration, Denver, CO (United States). Safety and Health Technology Center. 1994. 302p. Sponsored by Department of Labor, Washington, DC (United States). Order Number DE94011059. Source: OSTI; NTIS.

This Mine Safety and Health Administration (MSHA) informational report reviews in detail the occupational injury and illness experience of nonmetallic mineral mining (except stone and coal) in the United States for 1992. Data reported by operators of mining establishments concerning work injuries are summarized by work location, accident classification, part of body injured, nature of injury, occupation, and principal type of mineral. Related information on employment, worktime, and operating activity also is presented. Data reported by independent contractors performing certain work at mining locations are depicted separately in this report. For ease of comparison with other metal and nonmetallic mineral mining industries and with coal mining, summary reference tabulations are included at the end of both the operator and the contractor sections of this report.

22745 (ORNL/TM–12456) **Highway crash rates and age-related driver limitations: Literature review and evaluation of data bases.** Hu, P.S. (Oak Ridge National Lab., TN (United States)); Young, J.R.; Lu, An. Oak Ridge National Lab., TN (United States). Aug 1993. 116p. Sponsored by Department of Transportation, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94011605. Source: OSTI; NTIS; GPO Dep.

American society is undergoing a major demographic transformation that is resulting in a larger proportion of older individuals in the population. Moreover, recent travel surveys show that an increasing number of older individuals are licensed to drive and that they drive more than their same age cohort a decade ago. However, they continue to take shorter trips than younger drivers and they avoid driving during congested hours. This recent demographic transformation in our society, the graying of America, coupled with the increasing mobility of the older population impose a serious highway safety issue that cannot be overlooked. Some of the major concerns are the identification of "high-risk" older drivers and the establishment of licensing guidelines and procedures that are based on conclusive scientific evidence. Oak Ridge National Laboratory's (ORNL) objectives in this project can be characterized by the following tasks: Review and evaluate the 1980 American Association of Motor Vehicle Administrators (AAMVA) and National Highway Traffic Safety Administration (NHTSA) licensing guidelines. Determine whether the license restriction recommended in the 1980 AAMVA and NHTSA guidelines was based on scientific evidence or on judgement of medical advisors. Identify in the scientific literature any medical conditions which are found to be highly associated with highway crashes, and which are not mentioned in the 1980 guidelines. Summarize States' current licensing practices for drivers with age-related physical and mental limitations. Identify potential data sources to establish conclusive evidence on age-related functional impairments and highway crashes.

22746 (RFP–4836) **Rocky Flats Plant Live-Fire Range Risk Analysis Report.** Nicolosi, S.L.; Rodriguez, M.A. EG and G Rocky Flats, Inc., Golden, CO (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90RF62349. (CONF-9406154–1: Energy facility contracts group meeting, Albuquerque, NM (United States), 7-9 Jun 1994). Order Number DE94009964. Source: OSTI; NTIS; GPO Dep.

The objective of the Live-Fire Range Risk Analysis Report (RAR) is to provide an authorization basis for operation as required by DOE 5480.16. The existing Live-Fire Range does not have a safety analysis-related authorization basis. EG&G Rocky Flats, Inc. has worked with DOE and its representatives to develop a format and content description for development of an RAR for the Live-Fire Range. Development of the RAR is closely aligned with development of the design for a baffle system to control risks from errant projectiles. DOE 5480.16 requires either an RAR or a safety analysis report (SAR) for live-fire ranges. An RAR rather than a SAR was selected in order to gain flexibility to more closely address the safety analysis and conduct of operation needs for a live-fire range in a cost-effective manner.

22747 (SAND–93-2509C) **Protecting Earth from comet/asteroid impacts through international cooperation: Issues & current status.** Tedeschi, W. Sandia National Labs., Albuquerque, NM (United States); Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science. [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405148–1: 19. international symposium on space technology and science, Yokohama (Japan), 15-24 May 1994). Order Number DE94012069. Source: OSTI; NTIS; GPO Dep.

Compelling evidence of a catastrophic asteroid impact on Earth 65 million years ago has given rise to international discussions about the probability, consequences, and prevention of future impacts. Because asteroid and comet impacts pose a grave danger to all humanity, preventive defensive measures should appropriately be based on international cooperation and action. Action may consist of detection research, experimentation to prevent the impact, public education on the issues, emergency planning, and actual protection if required. This paper provides background information on the threat posed by Near-Earth Objects (NEOs) and discusses associated technical and geopolitical issues and the current status of some related international activities.

22748 (SAND–94-0920) **Generic safety documentation model.** Mahn, J.A. Sandia National Labs., Albuquerque, NM

(United States). Apr 1994. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94011413. Source: OSTI; NTIS; INIS; GPO Dep.

This document is intended to be a resource for preparers of safety documentation for Sandia National Laboratories, New Mexico facilities. It provides standardized discussions of some topics that are generic to most, if not all, Sandia/NM facilities safety documents. The material provides a "core" upon which to develop facility-specific safety documentation. The use of the information in this document will reduce the cost of safety document preparation and improve consistency of information.

5701 Real Accidents

Refer also to citation(s) 21326

58 GEOSCIENCES

Refer also to citation(s) 20738, 20739, 20740, 20742, 20743, 20759, 20760, 20762, 20764, 20785, 20865, 20908, 20934, 20970, 20973, 20974, 20975, 20978, 20993, 20994, 21059, 21378, 22068, 22466

22749 (ANL/CMT/PP–78377) **Ga, Ca, and 3d transition element (Cr through Zn) partitioning among spinel-lherzolite phases from the Lanzo massif, Italy: Analytical results and crystal chemistry.** Wogelius, R.A. (Argonne National Lab., IL (United States)); Fraser, D.G. Argonne National Lab., IL (United States). [1994]. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012640. Source: OSTI; NTIS; GPO Dep.

Ultramafic rocks exposed in Lanzo massif, Italy is a record of mantle geochemistry, melting, sub-solidus re-equilibration. Plagioclase(+ spinel)-lherzolite samples were analyzed by Scanning Proton Microscopy, other techniques. Previous work postulated partial melting events and a two-stage sub-solidus cooling history; this paper notes Ga enrichment on spinel-clinopyroxene grain boundaries, high Ga and transition element content of spinel, and pyroxene zonation in Ca and Al. Trace element levels in olivine and orthopyroxene are also presented. Zoning trends are interpreted as due to diffusion during cooling. Olivine-clinopyroxene Cr and Ca exchange as well as clinopyroxene and spinel zonation trends indicate that the massif experienced at least two sub-solidus cooling episodes, one at 20 kbar to 1000 C and one at 8 kbar <750C. Ga levels in cores of Lanzo high-Cr spinels are high (82-66 ppM) relative to other mantle spinels (66-40 ppM), indicating enrichment. Ga content of ultramafic spinels apparently increases with Cr content; this may be due to: increased Ga solubility stemming from crystal chemical effects and/or higher Ga activities in associated silicate melts. Thus, during melting, high-Cr residual spinel may tend to buffer solid-phase Ga level. These spinels are not only rich in Ga and Cr (max 26.37 el. wt %), but also in Fe (max 21.07 el. wt %), Mn (max 3400 ppM), and Zn (max 2430 ppM). These enrichments are again due to melt extraction and partitioning into spinel structure. Low Ni (min 1050 ppM) levels are due to unsuccessful competition of Ni with Cr for octahedral structural sites caused by crystal field. Comparisons of change in partitioning vs Cr content among several 3d transition elements for spinels from Lanzo, other localities allow us to separate crystal field effects from bulk chemical effects and to show that in typical assemblages, inversion of olivine-spinel partition coefficient for Ni from <1 to >1 should occur at 11% el. wt. Cr in spinel.

22750 (DOE/BC/14953–6) **Analysis of lithofacies, petrology/petrography, and porosity/permeability of the lower green river formation: Willow Creek.** Morris, T.H., Garner, A. Brigham Young Univ., Provo, UT (United States). 14 Apr 1994. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14953. Order Number DE94013937. Source: OSTI; NTIS; GPO Dep.

The 849.16 meter stratigraphic section was measured during consecutive spring field seasons. This section represents the "lower" Green River Formation which on the southwest flank of the basin rests stratigraphically above the dominant red beds of the Colton Member of the Green River Formation. The transition from Colton rocks to Green River rocks is gradual in the study area. Petrographic classification and textural analysis has been completed on 33 thin sections. These thin sections represent the volummetric majority of rock types in the measured section as well as few less common but very interesting lithofacies. Core plugs were taken from every lithology that was petrologically analyzed. Permeabilities were analyzed using a pressure transducer in a Hassler sleeve. Porosities from the lab were compared to point count porosities. In general there was good agreement and where there is some disagreement an explanation is given in the petrologic description. It appears that the sandstone lithofacies have much greater interparticle porosity. This is important to the study because these sandstones likely have greater hydrocarbon storage capacity than do the carbonate rocks. The data from this report have not been fully interpreted. There are several items relative to deposition facies interpretations and reservoir quality studies that are not as yet accomplished.

22751 (DOE/ER/13437–T3) **Thermodynamics of minerals stable near the earth's surface: [Annual] project summary report, [February 1, 1993–January 31, 1994].** Navrotsky, A. Princeton Univ., NJ (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13437. Order Number DE94012479. Source: OSTI; NTIS; GPO Dep.

The following are studied/discussed: high-temperature oxide melt calorimetry using molten $2PbO{\cdot}B_2O_3$; final state of H_2O and CO_2 on dissolution of crystalline volatile-bearing phase; enthalpy of interaction of water with lead borate; thermochemistry of amphiboles, micas, zeolites, and carbonates in the $(Mg,Fe,Ca)CO_3$ system; radiation damage in minerals (zircons); and crystalline silicas.

22752 (LBL–35560) **Approximating the imbibition and absorption behavior of a distribution of matrix blocks by an equivalent spherical block.** Zimmerman, R.W.; Bodvarsson, G.S. Lawrence Berkeley Lab., CA (United States). Mar 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-940553–62: International high-level radioactive waste management conference, Las Vegas, NV (United States), 22-26 May 1994). Order Number DE94013105. Source: OSTI; NTIS; INIS; GPO Dep.

A theoretical study is presented of the effect of matrix block shape and matrix block size distribution on liquid imbibition and solute absorption in a fractured rock mass. It is shown that the behavior of an individual irregularly-shaped matrix block can be modeled with reasonable accuracy by using the results for a spherical matrix block, if one uses an effective radius $\bar{a} = 3V/A$, where V is the volume of the block and A is its surface area. In the early-time regime of matrix imbibition, it is shown that a collection of blocks of different sizes can be modeled by a single equivalent block, with an equivalent radius of $\langle a^{-1} \rangle^{-1}$, where the average is taken on a volumetrically-weighted basis. In an intermediate time regime, it is shown for the case where the radii are normally distributed that the equivalent radius is reasonably well approximated by the mean radius $\langle a \rangle$. In the long-time limit, where no equivalent radius can be rigorously defined, an asymptotic expression is derived for the cumulative diffusion as a function of the mean and the standard deviation of the radius distribution function.

22753 (PNL–9390) **Statistical parameter selection for RMS Lg amplitudes.** Hagedorn, D.N.; Anderson, K.K.; Simpson, D.B. Pacific Northwest Lab., Richland, WA (United States). May 1994. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012377. Source: OSTI; NTIS; GPO Dep.

The Lg regional phase as a measure of seismic magnitude has a long history, beginning with Aki (1969). Aki's theoretical work was refined by Herrmann (1980), and by Nuttli (1986, 1988). Nuttli used as a measure of magnitude, the third largest amplitude (peak-to-peak) in the 3.6 to 3.2 km/sec velocity (time) window. This measurement was corrected for instrument response, geometrical spreading, and anelastic attenuation, as calculated from information measured in the Lg coda, then extrapolated back to a theoretical amplitude at a distance of 10 km. Nuttli's methodology is summarized by Hagedorn and Nicholson, by Hansen et al. (1990), and by

Israelsson (1992a, 1992b). Many later researchers have continued investigations into the Lg phase waves in order to better use the information in this phase for reliable magnitude/yield estimations. Patton (1988) automated the Lg magnitude measurement procedure by computing a RMS magnitude. Ringdal (1983), Ringdal and Hokland (1987), and Ringdal (1991) continued to refine and test the methodology and its stability. The Lg magnitude is a very stable estimator of energy. Hansen et al. (1990) found that RMS Lg amplitudes from events at Shagan River are extremely stable, as measured at NORSAR. Ringdal (1991) stated that because Lg consists of the superposition of many higher-mode surface waves with group velocities near 3.5 km/sec, it represents a more isotropic energy field than that from Pn. He also found that mb(Lg) may be estimated consistently with a noise standard deviation of about 0.03 magnitude units. Carter, et al. (1991) compared the results from four stations and found noise standard deviations of 0.59-0.90.

66 PHYSICS

6610 General Physics

22754 (INIS-mf–13808) **43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.** Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German, English). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

There are about 300 contributions presented by title and abstract only. The range of subject matters covered is indicated by the headings of topical sessions: (1) acoustics (2) atomic-, molecular- and plasma physics (3) solid-state physics (4) nuclear- and particle physics (5) school teachers' continuing education (6) medical-, bio- and environment physics (7) polymer physics (8) quantum electronics, electrodynamics and optics. 61 of the contributions are of INIS interests and are treated separately.

22755 (JINR-E–2-93-371) **On quantum deformation of the Schwarzschild solution.** Kazakov, D.I.; Solodukhin, S.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 24p. Order Number DE94626639. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nuclear Physics.

We consider the deformation of the Schwarzschild solution in general relativity due to spherically symmetric quantum fluctuations of the metric and the matter fields. In this case, the 4 D theory of gravity with Einstein action reduces to the effective two-dimensional dilaton gravity. We have found that the Schwarzschild singularity at r=0 is shifted to the finite radius $r_{min} \approx r_{PL}$, where the scalar curvature is finite, so that the space-time looks regular and consists of two asymptotically flat sheets glued at the hypersurface of constant radius. (author). 17 refs.; 4 figs.

22756 (JINR-E–2-93-416) **Covariant differential complexes of quantum linear groups.** Isaev, A.P.; Pyatov, P.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 23p. Order Number DE94626640. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Communications in Mathematical Physics.

We consider the possible covariant external algebra structures for Cartan's 1-forms (Ω) on G L_q (N) and S L_q (N). Our starting point is that Ω s realize an adjoint representation of quantum group and all monomials of Ω s possess the unique ordering. For the obtained external algebras we define the differential mapping d possessing the usual nilpotence condition, and the generally deformed version of Leibnitz rules. The status of the known examples of G L_q (N)-differential calculi in the proposed classification scheme and the problems of S L_q(N)-reduction are discussed. (author.). 26 refs.

22757 (JINR-E–2-93-424) **General relativity and dark matter.** Pestov, A.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 10p. Order Number DE94626641. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Zhurnal Ehksperimental'noj i Teoreticheskoj Fiziki.

It is shown that from the first principles of General Relativity it follows that there exists a new type of interactions which are tightly connected with the gravitational interactions. New particles representing a new form of interactions do not interact electromagnetically, strongly and weakly with the known elementary particles. Physics of the new particles is defined by the Planck scales. (author.). 9 refs.

6611 Classical and Quantum Mechanics

Refer also to citation(s) 22791

22758 (ANL/PHY/CP–82991) **What did we learn from the Aharonov-Bohm effect? Is spin 1/2 different?.** Peshkin, M. Argonne National Lab., IL (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405166–1: Workshop on the quantum systems: new trends, methods and results, Minsk (Belarus), 22 May - 1 jun 1994). Order Number DE94013318. Source: OSTI; NTIS; INIS; GPO Dep.

I review what has been learned about fundamental issues in quantum mechanics from the Aharonov-Bohm effect. Following that, I consider the Aharonov-Casher effect and the Scalar Aharonov-Bohm effect, in both of which a spin-1/2 particle interacts with a local electromagnetic field through its magnetic moment, and conclude that those effects can be described as observable effects of local torques.

22759 (CBPF-NF–035/92) **A new class of quantum potentials: the conditionally exactly soluble ones.** Souza Dutra, A. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 13p. Order Number DE94626642. Source: OSTI; NTIS (US Sales Only); INIS.

A new class of quantum-mechanical potentials is presented. Which are in the midway between the exactly solvable potentials and the quasi-exactly ones. Their fundamental feature is that one can find the entire spectrum of a given potential, provided that some of its parameters be conveniently fixed. (author).

22760 (CBPF-NF–037/92) **Lie algebras for the Dirac-Clifford ring.** Mignaco, J.A. (Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil)); Linhares, C.A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 27p. Order Number DE94626643. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown in a general way that the Dirac-Clifford ring formed by the Dirac matrices and all their products, for all even and odd spacetime dimensions D, span the cumulation algebras $SU(2^{D/2})$ for even D and $SU(2^{(D-1)/2}) + SU(2^{(D-1)/2})$ for odd D. Some physical consequences of these results are discussed. (author).

22761 (DOE/ER/40200–325) **Decoherence plus spontaneous symmetry breakdown generate the "ohmic" view of the state-vector collapse.** Ne'eman, Y. (Tel-Aviv Univ. (Israel). Beverly and Raymond Sackler Faculty of Exact Sciences). Texas Univ., Austin, TX (United States). Jun 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER40200. (TAUP-N–230-93). Order Number DE94013525. Source: OSTI; NTIS; INIS; GPO Dep.

The collapse of the state-vector is described as a phase transition due to three features. First, there is the atrophying of indeterminacy for macroscopic objects – including the measurement apparatus. Secondly, there is the environment decohering mechanism, as described by Zeh, Joos and others – dominant in macroscopic objects. As a result, the classical background, an input in the Copenhagen prescriptions, is generated as an "effective" picture, similar to the "effective" introduction of Ohmic resistance or of thermodynamical variables, when going from the micro to the macroscopic; in this case, the collectivized substrate is provided by the multiplicity of photon scatterings, etc., on top of the effect of the large number of particles in macroscopic objects. Thirdly, there is the Everett "branching", i.e. the materialization of one of the now decoherent states, accompanied by the destruction of the other branches. By definition, quantum indeterminancy represents a symmetry; in a measurement, or in a branching, this symmetry is broken "spontaneously", involving a Ginzburg-Landau type potential

with asymmetric minima, thus concretizing the quantum "dice" without the burden of "many worlds". The authors review and systematize the various phase transitions relating quantum to classical phenomena.

22762 (INIS-mf–13808, pp. 64) **Time-selective interferometry and particle-number-phase uncertainty.** Zawisky, M. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Rauch, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRONS/interferometry; NEUTRONS; INTERFEROMETRY; UNCERTAINTY PRINCIPLE

22763 (INIS-mf–13808, pp. 66) **The effective mass of the neutron and of its Coriolis deviation.** Raum, K. (Innsbruck Univ. (Austria). Inst. fuer Experimentalphysik); Weinfurter, A.; Zeilinger, A.; Gaehler, R.; Koellner, M.; Arif, M.; Greene, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRONS/effective mass; CORIOLIS FORCE; NEUTRONS

22764 (INIS-mf–13870, pp. 81-82) **Nonlinear models in quantum physics.** Chadzitaskos, G. (Czech Technical University, Prague (Czech Republic). Faculty of Mechanical Engineering); Kostal, K. Ceske Vysoke Uceni Technicke, Prague (Czech Republic). 30 Apr 1994. (CONF-940184–: CTU seminar 94, Prague (Czech Republic), 17-20 Jan 1994). In *Proceedings of the CTU seminar 94. Pt. A.* 234p. Order Number DE94624077. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SCHROEDINGER EQUATION/nonlinear problems; QUANTIZATION; QUANTUM FIELD THEORY

22765 (INS–1021) **Quantization in curvilinear coordinates.** Nishimura, Kimihide. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jan 1994. 13p. Order Number DE94770603. Source: OSTI; NTIS; INIS.

The general covariant quantization method based on the equivalence principle is proposed. According to this method, it is found that an extra term: -1/3R appears in the Klein-Gordon equation. As a result, the effective mass of an electron, for example, will increase by the ratio of 10^{-35} at the center of a neutron star. (author).

22766 (JINR-E–2-93-425) **Physical meaning of confinement.** Pestov, A.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 11p. Order Number DE94626644. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yadernaya Fizika.

A notion is developed for quarks as tops, i.e. particles characterized not only by the mass, charge, spin but also by the moment of inertia. It is established that geometrical and field-theoretical methods allow a consistent introduction of interacting particles of that type. The main wave equation for describing the dynamics of quark-tops is proposed to be different from the Dirac equation for electrons. The charge of the Dirac equation naturally leads to the charge of Maxwell equations. It is shown that the Cornell potential expresses the Coulomb law for quark-tops. (author.). 7 refs.

22767 (JINR-R–4-93-427) **To the theory of the management of the resonance widths: How to predict qualitatively the form of the corresponding potential perturbations.** Zakhar'ev, B.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 7p. (In Russian). Order Number DE94626645. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physics Letters. B.

A simple physical explanation is given of the potential transformation which is necessary to increase (decrease) the probability of the decay of the chosen quasi-stationary state when the half-lives of all other states remain unchanged. The arbitrary changes of the resonances widths are provided by the special auxiliary 'carriers' (narrow local attractive wells) which are able to shift separately the chosen states through the potential barrier nearer to its outer end increasing the decay rate. The possibility to manage the form of wave functions for construction of quantum systems with the desired transition rates for the arbitrary chosen discrete spectrum is considered. (author.). 5 refs.; 4 figs.

22768 (LA-UR–94-1525) **Raman scattering of variable bandwidth KrF radiation in long air paths.** Kumit, N.A.; Thompson, D.C.; Thomas, S.J.; McCown, A.W.; Greene, D.S.; Gossein, C.; Steele, H.S. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9405157–2: 4. international workshop on KrF laser technology, Annapolis, MD (United States), 2-5 May 1994). Order Number DE94012912. Source: OSTI; NTIS; INIS; GPO Dep.

Previous experiments to study Raman scattering of narrow- and broad-band KrF radiation in long air paths have been repeated with larger-area, higher-energy beams of wider bandwidth over longer air paths, and with a more-comprehensive diagnostic systems. Parametric generation of Raman scattering has been observed with free-running bandwidth as well as with broader-band radiation and with a biharmonic pump. The effects of bandwidth on Raman threshold, output spectrum, and focusability will be reported.

22769 (LBL–34833) **Cartan calculus on quantum Lie algebras.** Schupp, P.; Watts, P.; Zumino, B. Lawrence Berkeley Lab., CA (United States). 9 Dec 1993. 14p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. GRANT PHY-90-21139. (UCB-PTH–93/32; CONF-9309378–1: 22. international conference on differential geometric methods in theoretical physics, Ixtapa (Mexico), 20-25 Sep 1993). Order Number DE94011794. Source: OSTI; NTIS; INIS; GPO Dep.

A generalization of the differential geometry of forms and vector fields to the case of quantum Lie algebras is given. In an abstract formulation that incorporates many existing examples of differential geometry on quantum spaces we combine an exterior derivative, inner derivations, Lie derivatives, forms and functions au into one big algebra, the "Cartan Calculus."

22770 (LBL–35497) **Studies in Chaotic adiabatic dynamics.** Jarzynski, C. Lawrence Berkeley Lab., CA (United States). Jan 1994. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94013111. Source: OSTI; NTIS; INIS; GPO Dep.

Chaotic adiabatic dynamics refers to the study of systems exhibiting chaotic evolution under slowly time-dependent equations of motion. In this dissertation the author restricts his attention to Hamiltonian chaotic adiabatic systems. The results presented are organized around a central theme, namely, that the energies of such systems evolve diffusively. He begins with a general analysis, in which he motivates and derives a Fokker-Planck equation governing this process of energy diffusion. He applies this equation to study the "goodness" of an adiabatic invariant associated with chaotic motion. This formalism is then applied to two specific examples. The first is that of a gas of noninteracting point particles inside a hard container that deforms slowly with time. Both the two- and three-dimensional cases are considered. The results are discussed in the context of the Wall Formula for one-body dissipation in nuclear physics, and it is shown that such a gas approaches, asymptotically with time, an exponential velocity distribution. The second example involves the Fermi mechanism for the acceleration of cosmic rays. Explicit evolution equations are obtained for the distribution of cosmic ray energies within this model, and the steady-state energy distribution that arises when this equation is modified to account for the injection and removal of cosmic rays is discussed. Finally, the author re-examines the multiple-time-scale approach as applied to the study of phase space evolution under a chaotic adiabatic Hamiltonian. This leads to a more rigorous derivation of the above-mentioned Fokker-Planck equation, and also to a new term which has relevance to the problem of chaotic adiabatic reaction forces (the forces acting on slow, heavy degrees of freedom due to their coupling to light, fast chaotic degrees).

6612 Techniques of General Use in Physics

Refer also to citation(s) 22322

22771 (ENEA-RT-INN–93-01) **Supersonic molecular beams: Physics fundamentals: Part 1.** Sanna, G. (L'Aquila Univ. (Italy). Ist. di Fisica); Tomassetti, G. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Apr 1993. 31p. (In Italian). (RT/INN–93-01). Order Number DE94775316. Source: OSTI; NTIS (US Sales Only).

This paper is the first of a series of reports to illustrate the basic knowledge in the field of supersonic beam expansion. The fundamental ideas for the understanding of this topic belong to different fields such as classical thermodynamics, statistical mechanics, the kinetic theory of gases, molecular spectra and energy transfer in molecular collisions. Given the extension of the concerned matter, the paper limits itself to consider only knowledges essential to the understanding of the developments met in following reports.

22772 (INIS-BR–3334) **Assembly and calibration of a new experimental apparatus for production and utilization of capture gamma rays.** Semmler, R. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1993. 73p. (In Portuguese). Order Number DE94626650. Source: OSTI; NTIS (US Sales Only); INIS.

A new experimental apparatus has been mounted at the tangential beam tube B H 4/12 of the IPEN IEA-R1 (2 MW) reactor, for production and utilization of capture gamma rays. In this type of experiment, monochromatic gamma radiation, with energy resolution of about 10 eV, is produced by thermal neutron capture in several materials placed near the reactor core. By changing the target material it was possible to obtain up to 30 gamma lines in the 5 to 11 MeV energy range and so, the present experimental arrangement may be considered as an excellent gamma ray source for photonuclear reactions studies in low excitation energies. (author).

22773 (INIS-mf–13808, pp. 58) **Operating characteristics of a 2.45 GHz- and a 5 GHz-EZR ion source.** Wutte, D. (Technische Univ., Vienna (Austria). Inst. fuer Allgemeine Physik); Leitner, M.; Brandstoetter, J.; Winter, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ION SOURCES/specifications; ARGON; HELIUM; SPECIFICATIONS; ION-ATOM COLLISIONS; KRYPTON; LITHIUM; NITROGEN; PLASMA DIAGNOSTICS

22774 (KFK–5286) **The none-equilibrium-plasma of a surface discharge on a metal hydrid film as an ion source.** Laqua, H.P. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Physik. Jan 1994. 133p. (In German). Order Number DE94773750. Source: OSTI; NTIS (US Sales Only); INIS.

One of the key problems in the developement of high power diodes is the formation of a suitable anode plasma source layer. To provide an ion current density of up to 10 kA/cm^2 for a pulse duration of 50 ns a minimum of 3x10^{15} ions/cm^2 is needed. This layer should uniformly cover an area of more than 100 cm^2 and smoothly conform to the desired anode shape without expanding far into the acceleration gap. A new anode plasma source (Ti-Pd film as hydrogen storage) for protons meeting these requirements was developed and investigated. (orig./HP)

6613 Other Aspects of Physical Science

Refer also to citation(s) 22452, 22463, 23061

22775 (DOE/ER/14303–2) **Stability and dynamics of spatio-temporal structures: Progress report, September 15, 1993–September 14, 1994.** Riecke, H. Northwestern Univ., Evanston, IL (United States). Dept. of Engineering Sciences and Applied Mathematics. May 1994. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14303. Order Number DE94013035. Source: OSTI; NTIS; GPO Dep.

Goal is to contribute to understanding of localized spatial and spatio-temporal structures far from thermodynamic equilibrium. Here we report on our progress in the study of three classes of systems. (1) We have studied cellular flame structures arising in a circular burner. Using numerical computations we have found a number of traveling-wave structures in which different cells undergo different motion. Most strikingly, we have found a localized wave traveling through the array of steady cells. Results are interpreted using various asymptotic approaches. They are in qualitative agreement with recent experiments. (2) We have continued our investigation of localized waves in binary-mixture convection. Starting from the extended Ginzburg-Landau equations introduced earlier, we have derived equations of motion for interacting fronts connecting the conductive and the convective state. These equations reveal a repulsive interaction between the fronts which implies a new localization mechanism for waves. It is solely due to the long-wavelength mode specific to the extended Ginzburg-Landau equations. The stability properties of the resulting localized waves are in qualitative agreement with very recent experiments. (3) We have extended our investigation of domain structures to include their temporal evolution.

22776 (FNAL/C–94/093) **The distributed development environment for SDSS software.** Berman, E. (Fermi National Accelerator Lab., Batavia, IL (United States)); Gurbani, V.; Mackinnon, B.; Newberg, H. Nicinski, T.; Petravick, D.; Pordes, R.; Sergey, G.; Stoughton, C.; Lupton, R. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–2: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013238. Source: OSTI; NTIS; INIS; GPO Dep.

The authors present an integrated science software development environment, code maintenance and support system for the Sloan Digital Sky Survey (SDSS) now being actively used throughout the collaboration.

22777 (LA-SUB–94-79) **NRL HF propagation mesurements between Guadeloupe and Providenciales during the CRRES exercises.** Los Alamos National Lab., NM (United States). [1994]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36 ; AI32-92AL82529. Order Number DE94012078. Source: OSTI; NTIS; GPO Dep.

During this experiment series, scientists from NRL and LANL deployed high frequency radio transmitters on the Caribbean island of Guadeloupe and receiving equipment on the island of Providenciales in the Turks and Caicos Islands. The objective of these tests was twofold: (1) to determine the effect of injecting chemical agents known to affect the ambient plasma into a region of the ionospheric F layer subject to "heating" by HF radiowaves (2) to assess the effect of the combined chemical and radiowave modification on HF skywave propagation through the modified ionosphere. Successful NRL channel probe measurements were made during experiments AA-3a (HF Induced Ionospheric Striations) and AA-4 (Ionospheric Focussed Heating). This report is intended to provide a brief description of some of the salient observational results from these two experiments.

22778 (LA-UR–94-1451) **The SESAME database.** Johnson, J.D. Los Alamos National Lab., NM (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940633–1: 12. symposium on thermophysical properties, Boulder, CO (United States), 19-24 Jun 1994). Order Number DE94011699. Source: OSTI; NTIS; GPO Dep.

The SESAME database has been in existence for over twenty years and has been provided to over three hundred users worldwide. Currently, we supply the following: equation of state and material properties data, including pressure, internal energy, and Helmholtz free energy as functions of density and temperature, shear modulus, melting curves, and vaporization information; electron transport properties, including electrical conductivity, thermal conductivity, thermoelectric coefficient, and electron conductive opacity; and opacity data, including mean ion charge, Rosseland mean opacity, and Planck mean opacity. The opacity and transport

data are available for the elements. The equation of state and material properties are for a broad variety of materials from elements, to composites, to compounds, to rocks. The ranges of density and temperature that are covered are typically extreme; from zero density to 10^5 gm/cc, from zero Kelvin to 10^9 Kelvin. We have supplied less general tables to users with their own specialized needs. We wish to continue such and to expand SESAME to SESAME++. This will be an enlarged database including more types of material data for an expanded group of users with more diverse interests.

22779 (LA-UR–94-1811) **Channel probe measurements for the American sector clutter experiment, January, 1994.** Fitzgerald, T.J. Los Alamos National Lab., NM (United States). 20 May 1994. 23p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013086. Source: OSTI; NTIS; GPO Dep.

The ionospheric phenomenon called Equatorial Spread F encompasses a variety of effects associated with plasma irregularities occurring in the post-sunset and nighttime ionosphere near the magnetic equator. These irregularities can seriously degrade the performance of systems which involve either of necessity or inadvertently radio propagation through the equatorial ionosphere. One such system is Over-the-Horizon (OTH) radars which operate in the high-frequency (hf) band and use ionospheric reflection for forward and backscatter propagation to ranges of thousands of kilometers. When such radars are directed towards the equator, Spread F irregularities can cause scintillation effects which may be aliased into the ranges of interest and have the effect of causing, excess clutter in which targets may be hidden. In January, 1994 Los Alamos participated in a campaign to measure Spread F effects on OTH propagation from the United States looking towards South America in conjunction with local diagnostics in Peru. During the campaign Los Alamos fielded a 1600 km bistatic path between Piura, Peru, and Arequipa, Peru-, the one-hop reflection region for this path was near the magnetic equator, We obtained four types of measurements: an oblique ionogram between Piura and Arequipa every three minutes; Doppler spread and spatial correlation for a single frequency cw path between Piura and Arequipa; Doppler spread, time-delay spread, and spatial coherence for a 10 kHz bandwidth path between Piura and Arequipa-, and Doppler spread and time-delay spread for the one-way path between the AVA radar in New York and Arequipa, Peru. This report describes the diagnostic experiments that we carried out and gives a brief description of some of the data we obtained.

22780 (LA-UR–94-1835) **Tongues, bottles, and disconnected loops: The opening and closing of the interplanetary magnetic field.** McComas, D.J. (Los Alamos National Lab., NM (United States). Space and Atmospheric Sciences Group). Los Alamos National Lab., NM (United States). [1994]. 16p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94013397. Source: OSTI; NTIS; GPO Dep.

US national report to the IUGG (1991–1994).

For years the field of Space Physics has had a problem, a really big problem for it occurs on the largest spatial scales in Space physics – across the entire region under the Sun's influence, the heliosphere. The problem is that the Sun appears to keep opening new magnetic flux into interplanetary space with no obvious way for this flux to close back off again. This state of affairs, without some previously unknown method for closing the open interplanetary magnetic field (IMF), leads to an ever growing amount of magnetic flux in interplanetary space: the magnetic flux catastrophe. Recently, considerable progress has been made in understanding why this catastrophic state is not the observed state of the heliosphere. This brief article paints the newly emerging picture of the opening and closing of the IMF and how these processes may account for the observed variation in the amount of magnetic flux in interplanetary space over the solar cycle.

22781 (LA-UR–94-1862) **A high precision gamma-ray spectrometer for the Mars-94 mission.** Mitrofanov, I.G. (Inst. for Space Research, Moscow (Russian Federation)); Anfimov, D.S.; Chernenko, A.M. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404169–1: Low cost planetary missions meeting, Laurel, MD (United States), 12-15 Apr 1994). Order Number DE94013133. Source: OSTI; NTIS; GPO Dep.

The high precision gamma-ray spectrometer (PGS) is scheduled to be launched on the Mars-94 mission in October 1994, and to go into an elliptical polar orbit around Mars. The PGS consists of two high-purity germanium (Ge) detectors, associated electronics, and a passive cooler and will be mounted on one of the solar panels. The PGS will measure nuclear gamma-ray emissions from the martian surface, cosmic gamma-ray bursts, and the high-energy component of solar flares in the broad energy range from 50 KeV to 8 MeV using 4096 energy channels.

22782 (SAND–93-1641) **A three-dimensional fast solver for arbitrary vorton distributions.** Strickland, J.H.; Baty, R.S. Sandia National Labs., Albuquerque, NM (United States). May 1994. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012581. Source: OSTI; NTIS; GPO Dep.

A method which is capable of an efficient calculation of the three-dimensional flow field produced by a large system of vortons (discretized regions of vorticity) is presented in this report. The system of vortons can, in turn, be used to model body surfaces, container boundaries, free-surfaces, plumes, jets, and wakes in unsteady three-dimensional flow fields. This method takes advantage of multipole and local series expansions which enables one to make calculations for interactions between groups of vortons which are in well-separated spatial domains rather than having to consider interactions between every pair of vortons. In this work, series expansions for the vector potential of the vorton system are obtained. From such expansions, the three components of velocity can be obtained explicitly. A Fortran computer code FAST3D has been written to calculate the vector potential and the velocity components at selected points in the flow field. In this code, the evaluation points do not have to coincide with the location of the vortons themselves. Test cases have been run to benchmark the truncation errors and CPU time savings associated with the method. Non-dimensional truncation errors for the magnitudes of the vector potential and velocity fields are on the order of $10^{-4}$and 10^{-3} respectively. Single precision accuracy produces errors in these quantities of up to 10^{-5}. For less than 1,000 to 2,000 vortons in the field, there is virtually no CPU time savings with the fast solver. For 100,000 vortons in the flow, the fast solver obtains solutions in 1 % to 10% of the time required for the direct solution technique depending upon the configuration.

22783 (UCRL-CR–115942) **Final report on spectral broadening by cross-phase modulation in linearly birefringent optical fibers.** Chen, C.J. (Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering); Wai, P.K.A.; Menyuk, C.R. Lawrence Livermore National Lab., CA (United States); Maryland Univ., Baltimore, MD (United States). Dept. of Electrical Engineering. Dec 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94010406. Source: OSTI; NTIS; GPO Dep.

Spectral widening by using the cross-phase modulation in a linearly birefringent optical fiber is investigated numerically. The coupled nonlinear Schroedinger equation that describes the wave propagation of each polarization in a birefringent optical fiber is discussed. Based on this equation, we generated computer simulations for different values of birefringence and dispersion. We found that a smooth output signal with intensity fluctuations of less than 10% and a spectral width of more than 50 Å is possible with low dispersion and low birefringence, e.g., D = −10 psec/nm-km and δn 2 x 10^{-5}. We also found that the Raman effect does not play an significant role.

22784 (UCRL-JC–115923) **Evolution of turbulent fields in explosions.** Kuhl, A.L. (Lawrence Livermore National Lab., El Segundo, CA (United States)); Bell, J.B.; Ferguson, R.E.; Chien, K.Y.; Collins, J.P.; Lyons, M.L. Lawrence Livermore National Lab., El Segundo, CA (United States). Dec 1993. 22p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48.

(CONF-940181–1: Japanese national symposium on shock waves, Chiba (Japan), 20-23 Jan 1994). Order Number DE94010405. Source: OSTI; NTIS; GPO Dep.

Explosions always contain turbulent mixing regions, e.g.: boundary layers, shear layers, wall jets and unstable interfaces. The inherent unsteadiness of turbulent mixing in explosions, and the lack of sufficient data, pose insurmountable difficulties for turbulence modeling of such flows. Proposed here is a direct numerical simulation approach-where the three-dimensional (3-D) conservation laws are integrated via a high-order Godunov method. Adaptive Mesh Refinement (AMR) is used to Capture the convective mixing processes on the computational grid. Then, an azimuthal-averaging operator is applied to the 3-D solution-in order to extract the instantaneous mean and fluctuating components of the turbulent field. This methodology is applied to the numerical simulation of the turbulent wall jet and dusty boundary layer flow induced by a point explosion above a ground surface. Principal results include the evolution of the turbulent velocity field near the surface. During the wall jet phase, the mean profiles resemble our previous two-dimensional calculations, while the velocity fluctuation profiles and Reynolds stress profiles are qualitatively similar to measurements of self-preserving wall jets. During the boundary layer phase, the mean velocity profile evolved with time, e.g.: initially it agreed with measurements of a dusty boundary layer behind a shock; at intermediate times it resembled the dusty boundary layer profiles measured in a wind tunnel; while at late times, it approached a 1/7 power-law profile. Velocity fluctuation profiles were qualitatively similar to those measured for a turbulent boundary layer on a flat plate. The methodology can be used to predict the evolution of other turbulent fields such as dust clouds, axisymmetric jets, fireball instabilities, and dusty boundary layers in shock tube and wind tunnel flows.

22785 (UCRL-JC–115947-Rev.1) **Time-resolved probing of electron thermal transport in plasma produced by femtosecond laser pulses: Revision 1.** Vu, B.T.V.; Szoke, A.; Landen, O.L.; Lee, R.W. Lawrence Livermore National Lab., CA (United States). 20 Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940889–2-Rev.1: Topical meeting on high field interactions and short wavelength generation, Saint Malo (France), 22-24 Aug 1994). Order Number DE94012061. Source: OSTI; NTIS; GPO Dep.

We present the first direct observation of a supersonic ionization front supported by electron thermal transport in a hot solid density plasma produced by 100fsec-laser-pulse irradiation of a transparent fused quartz target.

6620 Physics of Elementary Particles and Fields

Refer also to citation(s) 22753

22786 (ANL-HEP-CP–93-92) **Proceedings of the workshop on physics at current accelerators and supercolliders.** Hewett, J.L.; White, A.R.; Zeppenfeld, D. (eds.). Argonne National Lab., IL (United States). [1993]. 401p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9306176–: Workshop on physics at current accelerators and the supercollider, Argonne, IL (United States), 2-5 Jun 1993). Order Number DE94012388. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers from the workshop on SSC physics. The topics of these papers include: electroweak physics; electroweak symmetry breaking; heavy flavors; searches for new phenomena; strong interactions and full acceptance physics; and event simulation. These paper have been cataloged separately on the data base.

22787 (FNAL-TM–1887) **Particle physics.** Green, D. Fermi National Accelerator Lab., Batavia, IL (United States). May 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94012944. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: The standard model – synthesis and overview; accelerators and other facilities; mapping the SM constituents onto the detectors; a model pp/$\bar{p}$p collider detector; and other experimental techniques.

6621 General Theory of Particles and Fields

Refer also to citation(s) 22814, 22816, 22829, 22830, 22849, 22850, 22851, 22852, 22853, 22854, 22855, 22856, 22860, 22864, 22872, 22875, 22899, 22900, 22901

22788 (DOE/FTR–94006303) **Travel to Japan to attend the KEK conference on CP Violation: Foreign trip report, November 14–22, 1993.** Roodman, A.; Winstein, B. Fermi National Accelerator Lab., Batavia, IL (United States). 30 Nov 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE94006303. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Our attendance at the CP Violation conference served to enhance our understanding of the present status of experimental efforts to measure CP violating phenomena and the theoretical efforts to explain CP violation. The goal of our visit to Horiba Ltd. was to assess their CsI production status prior to the first scheduled shipment of crystals, due in February 1994 for the KTeV electromagnetic calorimeter. Horiba outlined their production schedule in detail. We discussed the crystal specifications. Finally Horiba presented results of a study on radiation damage.

22789 (IFT-P–005/94) **Evidence for coexistence of two phases in relativistic heavy ion collisions and comparison with lattice results.** Dey, J. (Fundacao de Amparo a Pesquisa do Estado de Sao Paulo (FAPESP), Sao Paulo, SP (Brazil)); Krein, G.; Tomio, L.; Frederico, T. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jan 1994. 13p. Order Number DE94626672. Source: OSTI; NTIS (US Sales Only); INIS.

The combined CERN and Brookhaven heavy ion (H.I) data supports a scenario of hadron gas which is in chemical and thermal equilibrium at a temperature T of about 140 MeV. Using the Brown-Stachel-Welke model (which gives 150 MeV). It is shown that in this scenario, the hot nucleons have mass 3 πT and the π and ρ mesons have masses close to πT and 2πT. This provides a possible connection with Euclidean time lattice masses of quarks. A simple model with pions and quarks supports the co-existence of two phases in these heavy ion experiments, suggesting a second order phase transition. (author).

22790 (INS–1017) **Construction of non-critical string field theory by transfer matrix formalism in dynamical triangulation.** Watabiki, Yoshiyuki. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1993. 67p. Order Number DE94770607. Source: OSTI; NTIS; INIS.

We propose a new method which analyzes the dynamical triangulation from the viewpoint of the non-critical string field theory. By using the transfer matrix formalism, we construct the non-critical string field theory (including $c > 1$ cases) at the discrete level. For pure quantum gravity, we succeed in taking the continuum limit and obtain the $c = 0$ non-critical string field theory at the continuous level. We also study about the universality of the non-critical string field theory. (author).

22791 (JINR-E–2-93-439) **Zero modes of first class secondary constraints in gauge theories.** Khvedelidze, A.; Pervushin, V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 22p. Order Number DE94626659. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yadernaya Fizika.

Zero modes of first class secondary constraints in the two-dimensional electrodynamics and the four-dimensional SU(2) Yang-Mills theory are considered by the method of reduced phase space quantization in the context of the problem of a stable vacuum. We compare the description of these modes in the Dirac extended method and reveal their connection with the topological structure of the gauge symmetry group. Within the framework of the 'reduced' quantization we construct a new global realization of the homotopy group representation in the Yang-Mills theory, where the role of the stable vacuum with a finite action plays the Prasad-Sommerfeld solution. (author.). 19 refs.

22792 (SLAC-PUB–6491) **Testing violation of CPT and quantum mechanics in the $K_0 - \bar{K}_0$ system.** Huet, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1994. 7p. Sponsored by USDOE, Washington, DC (United States).

DOE Contract AC03-76SF00515. (CONF-9403118–1: 1. international conference on phenomenology of unification from present to future, Roma (Italy), 23-26 Mar 1994). Order Number DE94012057. Source: OSTI; NTIS; INIS; GPO Dep.

I report a recent study made in collaboration with M.E. Peskin, on the time dependence of a kaon beam propagating according to a generalization of quantum mechanics due to Ellis, Hagelin, Nanopoulos and Srednicki, in which CP- and CPT-violating signatures arise from the evolution of pure states to mixed states. Constraints on the magnitude of its parameters are established on the basis of existing experimental data. New facilities such as ϕ factories are shown to be particularly adequate to study this generalization from quantum mechanics and to disentangle its parameters from other CPT violating perturbations of the kaon system.

22793 (SSCL-SR–1225, pp. 185-196) **New physics effects on CP violation in B decays.** Nir, Y. (Weizmann Institute of Science, Rehovot (Israel)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The author reviews new physics effects on CP violation in B decays. In chapter 2 he introduces the formalism, and discusses the Standard Model picture of CP violation in B decays, with special emphasis on the cleanliness of the predictions. Chapter 3 gives a general discussion of new physics effects: he points out the ingredients in the analysis that are sensitive to new physics and deduces the type of new physics that is most likely to modify the Standard Model predictions. Explicit examples are given in chapter 4: a model with Z-mediated flavor changing neutral currents demonstrates in which ways the new physics will manifest itself in CP asymmetries in B decays; a supersymmetric model with "quark-squark alignment" mechanism shows that supersymmetry may affect CP asymmetries in B decays, even though the minimal supersymmetric Standard Model does not; multi-scalar models may affect the asymmetries even in the absence of new CP violating phases; schemes for quark mass matrices will be crucially tested by the CP asymmetries. In chapter 5 he explains how, if deviations from the Standard Model predictions are measured, one will be able to learn detailed features of the New Physics that is responsible for that.

22794 (SSCL-SR–1225, pp. 411-415) **CP violation outside the standard model phenomenology for pedestrians.** Lipkin, H.J. (Weizmann Institute of Science, Rehovot (Israel)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract W-31109-ENG-38. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Before 1964 the two kaon flavor eigenstates K^0 and $\bar{K}^0$ carrying strangeness ± 1 were believed to be CP conjugate and mixed by a CP-conserving weak interaction into mass eigenstates K_S and K_L which were also CP eigenstates with opposite eigenvalues. Very different lifetimes arise ($\tau_S = 9\times10^{-11}$sec; $\tau_L = 5\times10^{-8}$sec) because the dominant 2π decay mode with largest phase space is allowed by CP only for K_S. $K_L \to 2\pi$ was a transition between CP-eigenstates with opposite eigenvalues and therefore forbidden. So far the only experimental evidence for CP violation is the 1964 discovery of $k_L \to 2\pi$ where the two mass eigenstates produced by neutral meson mixing both decay into the same CP eigenstate. This result is described by two parameters, $\eta_{+-} \equiv \epsilon + \epsilon'$; $\eta_{00} \equiv \epsilon - 2\epsilon'$. Today $\epsilon \approx$ its 1964 value, ϵ' data are still inconclusive and there is no new evidence for CP violation. One might expect to observe similar phenomena in other systems and also direct CP violation as charge asymmetries between decays of charge conjugate hadrons $H^\pm \to f^\pm$. Why is it so hard to find CP violation? How can B Physics help? Does CP lead beyond the standard model? The author now presents a pedestrian symmetry approach which exhibits the difficulties and future possibilities of these two types of CP-violation experiments, neutral meson mixing and direct charge asymmetry: what may work, what doesn't work and why.

22795 (SSCL-SR–1225, pp. 449-450) **New phases in CP violating B decay asymmetries from mixing to singlet down quarks.** Silverman, D. (Univ. of California, Irvine, CA (United States)); Choong, Woon-Seng. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Groups such as E_6 with extra $SU(2)_L$ singlet down quarks give rise to flavor changing neutral currents (FCNC) through the mixing of four or more down quarks. These FCNC with Z^0 mediated exchange may contribute part of $B^0_c - \bar{B}^0_d$ mixing and of $B^0_s - \bar{B}^0_s$ mixing, giving a range of non-zero values for the fourth quark's mixing parameters. If these are a large contributor to the $B_d - \bar{B}_d$ mixing, they introduce three new angles and two new phases into the CP violating B decay asymmetries. The size of the contribution of the FCNC amplitude U_{db} as one side of the unitarity quadrangle is less than 0.05 of the unit base at the 1-σ level, but the authors find that it can contribute as large an amount to $B_d - \bar{B}_d$ mixing as does the standard model. They find that the new phases can appear in this mixing as well as in $B_s - \bar{B}_s$ mixing, and give total phases completely different from that of the standard model in CP violating B decay asymmetries.

22796 (SSCL-SR–1225, pp. 451) **Chiral Lagranglans, soft-meson limits and effective Lagrangians.** Oakes, R.J. (Northwestern Univ., Evanston, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG02-91ER40684. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The distinguishing features of the Chiral Lagrangian, Soft-Meson limit, and Effective Lagrangian methods for estimating matrix elements are summarized.

6622 Specific Theories and Interaction Models; Particle Systematics

Refer also to citation(s) 22792, 22793, 22794, 22822, 22827, 22828, 22831, 22836, 22837, 22838, 22840, 22841, 22842, 22843, 22847, 22848, 22849, 22850, 22851, 22852, 22854, 22855, 22859, 22860, 22861, 22862, 22863, 22864, 22870, 22879, 22886, 22888, 22891, 22892, 22893, 22898, 22908, 22938, 22971

22797 (BNL–60276) **The standard model.** Marciano, W.J. Brookhaven National Lab., Upton, NY (United States). Mar 1994. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9306339–1: Theoretical Advanced Study Institute workshop, Boulder, CO (United States), 4-11 Jun 1993). Order Number DE94013027. Source: OSTI; NTIS; INIS; GPO Dep.

In these lectures, my aim is to provide a survey of the standard model with emphasis on its renormalizability and electroweak radiative corrections. Since this is a school, I will try to be somewhat pedagogical by providing examples of loop calculations. In that way, I hope to illustrate some of the commonly employed tools of particle physics. With those goals in mind, I have organized my presentations as follows: In Section 2, renormalization is discussed from an applied perspective. The technique of dimensional regularization is described and used to define running couplings and masses. The utility of the renormalization group for computing leading logs is illustrated for the muon anomalous magnetic moment. In Section 3 electroweak radiative corrections are discussed. Standard model predictions are surveyed and used to constrain the top quark mass. The S, T, and U parameters are introduced and employed to probe for "new physics". The effect of Z′ bosons on low energy phenomenology is described. In Section 4, a detailed illustration of electroweak radiative corrections is given for atomic parity violation. Finally, in Section 5, I conclude with an outlook for the future.

22798 (CBPF-NF–030/92) **Comparison of the anomalous and non-anomalous generalized Schwinger models via functional formalism.** Souza Dutra, A. de. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 33p. Order Number DE94626684. Source: OSTI; NTIS (US Sales Only); INIS.

The Green functions of the two versions of the two versions of the generalized Schwinger model, the anomalous and the non-anomalous one, in their higher order Lagrangian density form are calculated. Furthermore it is shown through a sequence of transformations that the bosonized Lagrangian density is equivalent to the former, at least for the bosonic correlation functions. The introduction of the sources from the beginning, leading to a gauge-invariant source term is also considered. It is verified that the two models have the same correlation functions only of the gauge-invariant sector is taken into account. Finally it is presented a generalization of the Wess-Zumino term, and its physical consequences are studied, in particular the appearance of gauge-dependent massive excitations. (author).

22799 (CBPF-NF–031/92) **Diquarks in deep inelastic scattering and the Gottfried sum rule.** Caruso, F. (Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil)); Leader, E. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 10p. Order Number DE94626685. Source: OSTI; NTIS (US Sales Only); INIS.

Previous attempts to invoke diquarks in deep inelastic scattering are based upon a specific model of the proton wave-function, involving either a pure quark-diquark structure or a superposition of three-quark and quark-diquark structures. In this paper diquarks are introduced in a general way without recourse to any wave-functions. Allowance is made both for their elastic and their inelastic scattering. It is argued that previous attempts to do this are incorrect. It is demonstrated, with complete generality, that diquarks cannot resolve the current disagreement between theory and experiment in the Gottfried sum rule. (author).

22800 (IFT-P–003/94) **$SU(4)_L$ x $U(1)_N$ model for the electroweak interactions.** Pisano, F.; Pleitez, V. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jan 1994. 12p. Order Number DE94626675. Source: OSTI; NTIS (US Sales Only); INIS.

Assuming the existence of right-handed neutrinos an electroweak model based on the gauge symmetry $SU(4)_L$ x $U(1)_N$ is considered. We study the neutral currents coupled to all neutral vector bosons present in the theory. There are no flavor changing neutral currents at tree level, coupled with the lightest neutral vector boson. (author).

22801 (IFT-P–004/94) **The Green's function in the Bloch-Nordsieck model for QED_3.** Pimentel, B.M.; Tomazelli, J.L. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jan 1994. 8p. Order Number DE94626680. Source: OSTI; NTIS (US Sales Only); INIS.

The electron Green's function is obtained in the Bloch-Nordsieck approximation of three-dimensional QED. Dimensional regularization is used in the intermediate stages of calculation. (author).

22802 (IFT-P–009/94) **Flattening of the resonance spectrum of hadrons from κ-deformed Poincare algebra.** Dey, J. (Fundacao de Amparo a Pesquisa do Estado de Sao Paulo (FAPESP), Sao Paulo, SP (Brazil)); Ferreira, P.L.; Tomio, L.; Choudhury, R.R. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Feb 1994. 15p. Order Number DE94626686. Source: OSTI; NTIS (US Sales Only); INIS.

It was recently defined by Lukierski a κ-deformed Poincare algebra which is characterized by having the energy-momentum and angular momentum sub-algebras not deformed. Further Biedenharn showed that on gauging the κ-deformed electron with the electromagnetic field, one can set a limit on the allowed value of the deformation parameter $\epsilon \equiv 1/\kappa < 1$ fm. It is shown that one gets Regge like angular excitations, J, of the mesons, non-strange and strange baryons, with a value of $\epsilon \approx 0.082$ fm and predict a flattening with J of the corresponding trajectories. The Regge fit improves on including deformation, particularly for the baryon spectrum. (author).

22803 (INIS-mf–13808, pp. 45) **Quantum field-theoretical description of the energy levels of toponium.** Kummer, W. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik); Moedritsch, W. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TOPONIUM/energy levels; BOUND STATE; FINE STRUCTURE; QUANTUM FIELD THEORY; TOPONIUM

22804 (INIS-mf–13808, pp. 47) **Monopoles around static charges in the compact quantum electrodynamics.** Buerger, W. (Inst. fuer Kernphysik, Technische Univ. Vienna, Vienna (Austria)); Faber, M.; Markum, H.; Mueller, M.; Zach, M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CHARGE CARRIERS/magnetic monopoles; MAGNETIC MONOPOLES/spatial distribution

22805 (INIS-mf–13808, pp. 166) **Instantons around static quark charges.** Sakuler, W. (Inst. fuer Kernphysik, Technische Univ. Wien, Vienna (Austria)); Faber, M.; Markum, H.; Olejnik, S. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. COLOR MODEL/instantons; QUANTUM CHROMODYNAMICS/vacuum states; QUARKS/confinement; INSTANTONS; QUARKS; CONFINEMENT

22806 (INIS-mf–13808, pp. 167) **Hints at the pion cloud around hadrons in quantum chromodynamics.** Faber, M. (Inst. fuer Kernphysik, Technische Univ. Wien, Vienna (Austria)); Mueller, M.; Schaler, M.; Gausterer, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HADRONS/pions; QUANTUM CHROMODYNAMICS/phase diagrams; STRONG INTERACTIONS/pions; CHIRAL SYMMETRY; HADRONS; PIONS

22807 (INIS-mf–13808, pp. 168) **Analysis of the N-flavor Schwinger model with functional integrals.** Gattringer, C. (Graz Univ. (Austria)); Seiler, E. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. FERMIONS/u-1 groups; ANALYTICAL SOLUTION; ETA PRIME-958 MESONS; FERMIONS; FLAVOR MODEL; TWO-DIMENSIONAL CALCULATIONS

22808 (INS–1022) **Universal parametrization for quark and lepton substructure.** Akama, Keiichi (Saitama Medical Coll., Moroyama (Japan)); Terazawa, Hidezumi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jan 1994. 13p. Order Number DE94770604. Source: OSTI; NTIS; INIS.

A universal parametrization for possible quark and lepton substructure is advocated in terms of quark and lepton form factors. It is emphasized that the lower bounds on compositeness scale, Λ_c,

to be determined experimentally strongly depend on their definitions in composite models. From the recent HERA data, it is estimated to be $\Lambda_c > 50$ GeV, 0.4 TeV and 10 TeV, depending on the parametrizations with a single-pole form factor, a contact interaction and a logarithmic form factor, respectively. (author).

22809 (JINR-E–2-93-433) **The behavior of the slope of elastic nucleon scattering at small transfer momenta and recent U A 4/2 data.** Goloskokov, S.V.; Kuleshov, S.P.; Selyugin, O.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 4p. Order Number DE94626687. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Modern Physics Letters A.

Theoretical predictions for the behavior of the slope of the nucleon-nucleon scattering and other parameters of the differential cross sections in the framework of the dynamic model are compared with the recent U A 4/2 data at small transfer momenta and at a centre-of-mass energy of 541 GeV. Predictions at superhigh energies are considered. (author.). 13 refs.; 1 fig.; 1 tab.

22810 (JINR-E–2-93-454) **What can be learnt from the new U A 4/2 data?.** Selyugin, O.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 7p. Order Number DE94626688. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physics Letters. B.

A careful analysis of the new data of the U A 4/2 collaboration reveals that these data give an essentially large value of ρ=Re T(s,t)/I m(s,t) that does not contradict the early U A 4 experiment. There are grounds for thinking that this experiment reveals for the first time a real possibility of the existence of the spin-flip amplitude at superhigh energies in the range of small transfer momenta. (author.). 15 refs.; 2 figs.; 1 tab.

22811 (SLAC-PUB–6490) **One-loop gauge theory amplitudes with an arbitrary number of external legs.** Bern, Z. (Univ. of California, Los Angeles, CA (United States). Dept. of Physics); Dunbar, D.C.; Dixon, L.; Kosower, D.A. Stanford Linear Accelerator Center, Menlo Park, CA (United States); California Univ., Los Angeles, CA (United States). Dept. of Physics. May 1994. 12p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract FG03-91ER40662 ; AC03-76SF00515. Grant PHY-9218990; Grant APBR-3222; Grant CRG-921322; Grant CRG- (HEP-PH–9405248; CONF-940280–2: Theoretical Physics Institute on continuous advances in quantum chromodynamics conference, Minneapolis, MN (United States), 17-20 Feb 1994). Order Number DE94013354. Source: OSTI; NTIS; INIS; GPO Dep.

The authors review recent progress in calculations of one-loop QCD amplitudes. By imposing the consistency requirements of unitarity and correct behavior as the momenta of two legs become collinear, they construct ansaetze for one-loop amplitudes with an arbitrary number of external legs. For supersymmetric amplitudes, which can be thought of as components of QCD amplitudes, the cuts uniquely specify the amplitude.

22812 (SSCL-SR–1225, pp. 109-119) **Light-quark, heavy-quark systems: An update.** Grinstein, B. (SSC Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The author reviews many of the recently developed applications of Heavy Quark Effective Theory techniques. After a brief update on Luke's theorm, he describes striking relations between heavy baryon form factors, and how to use them to estimate the accuracy of the extraction of $|B_{cb}|$. He discusses factorization and compares with experiment. An elementary presentation, with sample applications, of reparametrization invariance comes next. The final and most extensive chapter in this review deals with phenomenological lagrangians that incorporate heavy-quark spin-flavor as well as light quark chiral symmetries. He compiles many interesting results and discuss the validity of the calculations.

22813 (SSCL-SR–1225, pp. 175-183) **Beauty and the beast: What lattice QCD can do for B physics.** Kronfeld, A.S. (Fermi National Accelator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

One of the reasons why b-hadrons are interesting is that their properties (decays, mixing, CP violation) help determine the least well-known elements of the Cabibbo-Kobayashi-Maskawa (CKM) matrix. In each case, however, the standard-model expression for the (differential) decay rate follows the pattern: (experimental measurement) = (known factors)(QCD factor)(CKM factor). To extract the CKM factor from the measurement one must have reliable theoretical calculations in nonperturbative QCD. The only systematic, first-principles approach to nonperturbative QCD is the formulation on the lattice. The most promising calculational method has proven to be large-scale numerical computations.

22814 (SSCL-SR–1225, pp. 199-207) **Summary report of the working group on: Measurement of the angle α.** Jawahery, A. (Univ. of Maryland, College Park, MD (United States)); London, D.; Luk, K.B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In the framework of the standard model, CP violating asymmetries in decays of kaons or B hadrons can be described using the parameters of the CKM matrix, which includes a CP violating phase. The unitarity of the CKM matrix implies several triangular relations in the complex plane. A test of the unitarity relation and the CKM scheme for CP violation can be performed by measuring these angles and testing the relations, $\alpha+\beta+\gamma=180°$. The charge to this working group was to consider the feasibility of measuring the angle α using a hadron accelerator and to compare the capabilities of the various experimental options. For this study they focussed on experiments at the SSC with E_{beam}= 20 TeV and at the Tevatron with E_{beam}=1 TeV. For detector configurations, they formed three subgroups studying central collider experiments, forward collider experiments, and fixed target experiments. In each subgroup they compared the capabilities of several proposed or existing experiments using, for the most part, the results of the simulation studies provided by the proponents of each experiment. This report consists of a theoretical introduction, a brief description of some of the principal experimental issues involved in the measurements of CP asymmetries in modes sensitive to the angle α, followed by a set of tables comparing the capabilities of various experimental options.

22815 (SSCL-SR–1225, pp. 247-249) **Comparing the physics reach of detectors in measuring CP violating angle β.** Toki, W. (Colorado State Univ., Fort Collins, CO (United States)); Hassard, J.F. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

There have been attempts in the past to make quantitative comparison among present and proposed experiments seeking to measure the internal angles of the CKM unitarity triangle. The best known, which the authors shall call the Harrison Plot, puts the attainable error in sin (2β) against the year that error might be reached. Since there is huge uncertainty in the luminosity profiles of the proposed accelerators, the slope of these curves is recognized to be suspect. Furthermore, this representation makes no statement about the relative sizes of efficiency, dilution and number of events which determine the error. Here the authors present a complementary representation which allows a simple comparisons to be made, and which can be later extended to accommodate systematic errors and contributions to, say, the efficiencies, to be compared.

22816 (SSCL-SR–1225, pp. 357-359) **Report of the mixing sub-group of the δ working group (other B physics).** Ritchie, D.J. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Skarha, J.E.; Zieminski, A. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

With the mixing parameter x defined as $\Delta m/\Gamma$ for neutral B mesons, the ratio of the mixing parameters for the B_d and B_s mesons is given by: $x_d/x_s = |V_{td}/V_{ts}|^2(m_{B_d}/m_{B_s})(\tau_{B_d}/\tau_{B_s})(f^2_{B_d}B_d/(f^2_{B_s}Bs))$. The value of x_d is known to good precision ($x_d = 0.665 \pm 0.088$), and the ratio of theoretical form factors ($f^2_{B_d}B_d/(f^2_{B_s}B_s)$) should be calculated to 10%-20% accuracy within the next couple of years. THerefore, a measurement of x_s can provide a precise measurement of the $|V_{td}/V_{ts}|$ ratio. This information, coupled with the measurements of $|V_{ub}|$ and $|V_{cb}|$ from CLEO, enables an independent determination of the CKM unitarity triangle through a measurement of its sides, rather than angles. Present estimates for quantities entering the presented equation, predict a value of x_s within a range of 10 to 30 within the Standard Model.

22817 (SSCL-SR–1225, pp. 405-410) **A study of some rare self-tagging B decays.** Schwartz, A.J. (Princeton Univ., NJ (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

To observe a manifest violation of CP symmetry in the B system requires observing a difference in total or differential rate between decays of B's and $\bar{B}$'s. The necessity of knowing the initial-state flavor requires, for non-flavor specific decays such as ψK_s, identifying the b-flavored meson or baryon which was produced in association with the B of interest. Such 'opposite-side' tagging has been extensively studied and usually results in a significant loss in acceptance. An alternative method is to study decay channels which by virtue of charge, strangeness or other additive quantum numbers unambiguously identifies the b or $\bar{b}$ nature of the decaying B. For example, observing a final state of D^0K^- indicates B^- decay, while $\bar{D}^0K^+$ indicates B^+ decay. Thus to observe CP violation in an experiment producing equal numbers of B^+'s and B^-'s, one compares the number of observed D^0K^- decays to the number of observed $\bar{D}^0K^+$ decays. A difference in yields indicates a difference in decay rates. The author provides a partial list of self-tagging decay modes of current theoretical interest, along with the branching ratio and CP asymmetry expected from Standard Model physics.

6623 Specific Interactions, Decays and Processes

Refer also to citation(s) 22325, 22331, 22342, 22381, 22392, 22393, 22398, 22399, 22402, 22403, 22406, 22408, 22409, 22410, 22411, 22413, 22816, 22890, 22891, 22895, 22900, 22901, 22922, 22924, 22938

22818 (CBPF-NF–034/92) **Feynman-x and transverse momentum dependence of $D^{\pm}$ and D^0, D-bar^0 production in 250 GeV π^- - nucleon interactions.** Alves, G.A. (and others); Amato, S.; Anjos, J.C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 15p. (FERMILAB-PUB–92/208E.). Order Number DE94626698. Source: OSTI; NTIS (US Sales Only); INIS.

The differential cross-section with respect to Feynman-x (x_F) and transverse momentum (P_T) for charm meson production using targets of Be, Al, Cu, and W are measured. In the range $0.1 < x_F < 0.7$, $d\sigma/d\ x_F$ is well fit by the form $(1\text{-}x_F)^n$ with $n = 3.9 \pm 0.2$. The difference between n values for D^- and D^+ is 1.1 +- 0.4. However, an asymmetry of 0.18 ± 0.04 favoring the production of D^- compared to D^+ is found . In the lower P_T range, < 2 GeV, $d\sigma/d\ P_T{}^2$ is well fit by the from $\exp(\text{-}b \times P_T{}^2)$ with $b = 1.03 \pm 0.04$ GeV^{-2}, while in the higher P_T range, 0.8 to 3.6 GeV, it is well fit by the form $\exp(\text{-}b' \times P_T)$ with b' 2.76 $\pm$ 0.06 GeV^{-1}. The shape of the differential cross-section has no significant dependence on atomic mass of the target material. (author).

22819 (DOE/ER/03956–T6) **Bubble chamber studies of hadron and photon interactions: Progress report E-(40-1)-3956, 1 June 1977–31 May 1978.** Bugg, W.M. (Univ. of Tennessee, Knoxville, TN (United States)); Condo, G.T.; Hart, E.L. Energy Research and Development Administration, Washington, DC (United States). [1994]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AS05-76ER03956. Order Number DE94011569. Source: OSTI; NTIS; GPO Dep.

During the past year the research program of the University of Tennessee Bubble Chamber group has been very active. The major effort of the group continues to be the hybrid 30 inch bubble chamber experiments at Fermilab. In the area of conventional bubble chamber experiments, the study of γ-d interactions at 3 GeV/c has been completed and published, and work on the 15 GeV/c π^+-d experiment has also been completed up to the data summary tape level. There are only a few rolls of the 8 GeV/c π^--p film remaining to be measured. A new exposure has been taken of $\bar{p}$-D in the range 0-800 MeV/c in the 12 foot chamber at Argonne. Scanning and measuring of the film is currently underway.

22820 (FNAL/C–93/291-E) **Studies of quarkonia production with CDF.** Papadimitriou, V. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9306176–23: Workshop on physics at current accelerators and the supercollider, Argonne, IL (United States), 2-5 Jun 1993). Order Number DE94013220. Source: OSTI; NTIS; INIS; GPO Dep.

In the 1988–89 collider run the authors studied the reactions $p\bar{p} \rightarrow J/\psi(\psi(2S))X \rightarrow \mu^+\mu^-X$ by using 2.6 ± 0.2 pb^{-1} of data. This allowed them to shed some light on the quarkonia production mechanisms at the Tevatron energy. The production mechanisms of the J/ψ's ($\psi(2S)$'s) are B decays, direct charmonium production and the recently suggested gluon fragmentation. They have also reconstructed χ_c mesons through the decay chain $\chi_c \rightarrow J/\psi\gamma$, $J/\psi \rightarrow \mu^+\mu^-$ using the same data set. In the 1992–93 run they have approximately a factor of 5 more J/ψ's per pb^{-1} than in the previous run. They show the J/ψ mass spectrum from a 12 pb^{-1} sample which represents ca 60% of the 1992–93 data. From the measurement of the average b lifetime with inclusive J/ψ's they have indications that the fraction of J/ψ's coming from b's is lower than the one they assumed in the previous run. With the new data set they are also reconstructing a respectable sample of χ_c decays. This sample will be used to measure the fraction f_χ and to cross check the fraction f_b measured with the SVX. Since they can now measure the J/ψ differential cross section from b's and from χ_c's, it will be much easier to disentangle the different J/ψ production mechanisms. The authors know that several of the 1988–89 CDF b-quark cross section measurements were statistically limited or were derived under certain assumptions; they expect that the analysis of the data set they collected during the 1992–93 run will shed light onto the problem. From (14.3 ± 1.0) pb^{-1} of the 1992–93 data they also reconstructed 104 ± 21 $J/\psi K^{\pm}$ and 26 ± 8 $J/\psi K^{0*}$ events for $P_T{}^B > 6.0$ GeV/c and $P_T{}^B > 9.0$ GeV/c respectively. The corresponding b-quark cross sections are given.

22821 (FNAL/C–93/299-E) **Quarkonia production, b-quark production and $b\bar{b}$ correlation studies with CDF.** Papadimitriou, V. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9306258–16: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). Order Number DE94013221. Source: OSTI; NTIS; INIS; GPO Dep.

The high rate of $B\bar{B}$ production at the Tevatron makes it a unique place for the study of B production and decay. Although e^+e^- colliders provide a cleaner environment than hadron colliders for the study of B decays, CDF has shown that exclusive B channels can be successfully reconstructed in a harsh environment. Their data have been taken in $p\bar{p}$ collisions at $\sqrt{s} = 1.8$ TeV with the CDF detector during the 1988–89 and the 1992–93 collider runs. The CDF detector has been upgraded before the start of the 1992–93 run. The authors have collected ~21 pb^{-1} of data with this upgraded

detector during the 1992–93 run. During the 1988–89 collider run CDF has shown that once can study quarkonia physics and b physics even in a harsh $p\bar{p}$ collider environment. The data collected with the upgraded CDF detector during the 1992–93 run are leading them to a rich program which focuses on the production and decay of quarkonia and b-quarks, and which will answer many of the questions posed during the 1988–89 collider run. Results from both runs are concluded.

22822 (FNAL/C–93/301-E) **Prospects for measuring B_s mixing at CDF.** Skarha, J.E. (Johns Hopkins Univ., Baltimore, MD (United States). Dept. of Physics and Astronomy); Wicklund, A.B. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9306258–15: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). Order Number DE94013147. Source: OSTI; NTIS; INIS; GPO Dep.

The original design of the Collider Detector at Fermilab (CDF) was optimized for high p_T physics measurements associated with W and Z boson, top quark, and QCD jet production. This choice resulted in an emphasis on the central pseudorapidity region ($|\eta| < 1.0$) for detector coverage. Thus, CDF has excellent tracking, good calorimetry, and a suitable muon system in the central region. Even with this limited coverage, the large $\bar{p}p \rightarrow bX$ cross section of nearly 100 μbarns for $|\eta| < 1.0$ has allowed the CDF experiment to make many B physics measurements. In addition, with the successful operation of the CDF silicon vertex detector (SVX), the capability for making time-dependent B_s mixing measurements becomes a reality. Upgrade plans, which include extending the tracking and lepton identification into the forward region and the implementation of a high-rate DAQ system, make a time-dependent B_s mixing measurement an attractive goal during the anticipated high-luminosity Main Injector collider runs. We discuss here the feasibility and potential of making a B_s mixing measurement based on extrapolations of the current CDF detector performance using colliding beam data and the expected upgrade plans.

22823 (FNAL/C–94/124-E) **Mass identified particle production and Bose Einstein correlations at 1800 GeV.** Alexopoulos, T. E735 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). May 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9301109–5: 2. international conference on physics and astrophysics of quark-gluon plasma, Calcutta (India), 19-23 Jan 1993). Order Number DE94013418. Source: OSTI; NTIS; INIS; GPO Dep.

Results were shown on transverse momentum distributions of π, k and p from Fermilab experiment E735. This experiment, related to the search for quark gluon plasma, was run at the Fermilab Tevatron collider with $\bar{p}p$ collisions at $\sqrt{s}$ = 1800 GeV. Dependence of particle ratios on transverse momentum and center of mass energies was shown. Results were also shown on Bose Einstein correlations between pairs of identical pions and a measure of size and lifetime of the source.

22824 (INIS-mf–13808, pp. 31) **Solar neutrinos.** Hampel, W. (Max-Planck-Institut fuer Kernphysik, 69 Heidelberg 1 (Germany)). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SOLAR NEUTRINOS/

22825 (INS–1019) **Search for right-handed currents in the decay chain of $K^+ \rightarrow \mu^+\nu_\mu$, $\mu^+ \rightarrow e^+\nu_e\bar{\nu}_\mu$.** Aoki, M. (and others); Yamazaki, T.; Imazato. J. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1993. 65p. Order Number DE94770606. Source: OSTI; NTIS; INIS.

The asymmetry of positrons in the $K^+ \rightarrow \mu^+\nu$, $\mu^+ \rightarrow e^+\nu_e\bar{\nu}_\mu$ decay chain was measured in a search for right-handed weak currents in $\Delta S = 1$ semi-leptonic decay. High-intensity low-background monoenergetic polarized muons of 236 MeV/c momentum resulting from kaon decay at rest were directly extracted from a primary production target which was hit by a proton beam of the KEK 12-GeV proton synchrotron. Muons were stopped in a pure-aluminum plate, and the energy-integrated asymmetry of the decay positrons with respect to the incoming muon direction was determined to high precision. The observed asymmetry yielded ξP_μ = -0.9996 ± 0.0030(stat) ± 0.0048(sys). This result revealed no evidence of right-handed currents in this kaon-decay chain, and set a stringent bound on the mass of the right-handed weak boson. (author) 52 refs.

22826 (JINR-E–2-93-432) **^{4}He electromagnetic structure in unitary and analytic VMD model with strict OZI rule.** Strizenec, P. (Slovenska Akademia Vied, Bratislava (Slovakia). Geofyzikalny Ustav). Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 6p. Order Number DE94626716. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Journal of Physics. G, Nuclear Physics.

We present the results of a new analysis of ^{4}He electromagnetic form factor data, based on the unitary and analytic VMD model with the OZI rule to be taken strictly into account. (author.). 7 refs.; 2 figs.

22827 (SLAC-PUB–6477) **Hard diffraction and deep inelastic scattering.** Bjorken, J.D. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1994. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-940233–1: International workshop on deep inelastic scattering and related subjects, Eilat (Israel), 6-11 Feb 1994). Order Number DE94013353. Source: OSTI; NTIS; INIS; GPO Dep.

Since the advent of hard-collision physics, the study of diffractive processes - shadow physics - has been less prominent than before. However, there is now a renewed interest in the subject, especially in that aspect which synthesizes the short-distance, hard-collision phenomena with the classical physics of large rapidity-gaps. This is especially stimulated by the recent data on deep-inelastic scattering from HERA, as well as the theoretical work which relates to it. The word diffraction is sometimes used by high-energy physicists in a loose way. The author defines this term to mean: A diffractive process occurs if and only if there is a large rapidity gap in the produced-particle phase space which is not exponentially suppressed. Here a rapidity gap means essentially no hadrons produced into the rapidity gap (which operates in the "lego" phase-space of pseudo-rapidity and azimuthal angle). And non-exponential suppression implies that the cross-section for creating a gap with width $\Delta\eta$ does not have a power-law decrease with increasing subenergy $s=e^{\Delta\eta}$, but behaves at most like some power of pseudorapidity $\Delta\eta \approx \log(s)$. The term hard diffraction shall simply refer to those diffractive process which have jets in the final-state phase-space.

22828 (SLAC-PUB–6493) **Precise determination of the weak mixing angle from a measurement of A_{LR} in $e^+e^- \rightarrow Z^0$.** Woods, M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-940327–2: 29. Moriond meeting on quantum chromodynamics and high energy hadronic interactions, Les Arcs (France), 19-26 Mar 1994). Order Number DE94013355. Source: OSTI; NTIS; INIS; GPO Dep.

In the 1993 SLC/SLD run, the SLD recorded 50,000 Z events produced by the collision of longitudinally polarized electrons on unpolarized positrons at a center-of-mass energy of 91.26 GeV. The luminosity-weighted average polarization of the SLC electron beam was (63.0±1.1)%. The authors measure the left-right cross-section asymmetry in Z boson production, A_{LR}, to be 0.1628±0.0071(stat.)±0.0028(syst.) which determines the effective weak mixing angle to be $\sin^2\theta^{eff}_W$ = 0.2292 ± 0.0009(stat.) ± 0.0004(syst.).

22829 (SLAC-PUB–6511) **A study of jet handedness in hadronic Z^0 decays.** Muller, D. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-940327–1: 29. Moriond meeting on quantum

chromodynamics and high energy hadronic interactions, Les Arcs (France), 19-26 Mar 1994). Order Number DE94013358. Source: OSTI; NTIS; INIS; GPO Dep.

The authors have searched for inclusive signatures of polarization in hadronic jets from $Z^0 \rightarrow q\bar{q}$ decays using the 'jet handedness' method. They exploited the large polar angle asymmetry induced by the high SLC electron beam polarization to select samples of quark jets and antiquark jets, expected to be left- and right-polarized respectively. They find no evidence for jet handedness in their global sample and set a preliminary upper limit of 7% at 95% C.L. on the magnitude of the analyzing power of this technique. They have used the SLD vertex detector to exclude events containing heavy (b, c) quarks, in which the handedness is expected to be small due to the dominance of decays of spinless mesons. They find no evidence for jet handedness in this high-purity sample of light (u, d and s) quark jets, and set a preliminary upper limit of 11% on the magnitude of the analyzing power in this case. They have investigated several alternative definitions of jet handedness in an attempt to optimize the analyzing power. They find no evidence of jet handedness by any method.

22830 (SSCL-SR–1225, pp. 1-10) **CP violation in the standard model: The B meson system.** Gronau, M. (Israel Institute of Technology, Haifa (Israel)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The author shows how expected large CP asymmetries in B decays can determine CKM phases in manners which are free of hadronic uncertainties. With other (CP conserving) measurements, this may eventually serve to overconstrain the CKM matrix. A determination of the three angles of the unitarity triangle is based theoretically on different types of asymmetries and is expected to involve different levels of experimental difficulty. The most promising measurement seems at present to be that of the angle β in $B^0_d \rightarrow \psi K_s$. This is the simplest case of CP violation in decays of mixed $B^0\bar{B}^0$, which essentially involves no corrections from CP nonconservation in direct decay. In the asymmetry of $B^0_d \rightarrow \pi^+\pi^-$ ($\rho^{+-}\pi^{-+}$), which measures the angle α, one will have to disentangle direct decay CP violation from the measured asymmetry. This requires a good detector for neutral pions. A time-dependent determination of γ from direct decay CP violation in $B^{+-} \rightarrow D^0_{1,2}K^{+-}$ may be feasible if $BR(B^+ \rightarrow D^0K^+)$ is not too strongly color-suppressed. Finally the author presented a new idea of tagging neutral B mesons, based on their correlation with nearby pions. This may be a very promising possibility if one can establish experimentally a strong correlation.

22831 (SSCL-SR–1225, pp. 11-19) **B decays in the standard model and beyond.** London, D. (Universite de Montreal, Quebec (Canada)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This paper is a brief review of a set of B decays in and beyond the standard model. The author discusses only right-handed B decays, certain rare B decays, B_c decays, $B_s^0\overline{B}_s^0$ mixing, and T violation.

22832 (SSCL-SR–1225, pp. 19-28) **Heavy-flavor production.** Smith, J. (Institute for Theoretical Physics, Stony Brook, NY (United States)); Tung, W.K. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This review combines material on heavy quark production presented at the Snowmass Workshop in the opening plenary session by the first author on established theory; and in the closing plenary session by the second author summarizing work and discussions by two working groups - the heavy quark production subgroup of the morning delta group and the afternoon theory group. The introductory section contains: (i) a general discussion on heavy quarks and energy scales; and (ii) an overview of the kinematic regions and the theoretical approaches to heavy quark calculation. Sec 2 consists of a brief summary of the experimental status, including the main successes and problems in the comparison between data and existing theoretical calculations. Sec 3 reviews the well-known calculations on photoproduction, leptoproduction, and hadroproduction of heavy quarks. Sec 4 describes two current efforts to extend the region of validity of existing calculations, involving the resummation of relevant large logarithms inherent in fixed-order perturbative QCD calculations. Note that actual cross section values for individual experiments are not included in this article.

22833 (SSCL-SR–1225, pp. 29-43) **B decays-measurements and predictions.** Yamamoto, Hitoshi (Harvard Univ., Cambridge, MA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Hadronic decays of B mesons are reviewed. First, masses of B mesons and observed patterns together with physics behind them are discussed. Then the effective Hamiltonian responsible for major decays is present and its practical applications is discussed in the context of factorization. Various tests of factorization are then studied. For rare decays, the focus is placed, on $K\pi$, $\pi\pi$ final state and the penguin-mediated $X_s\gamma$. In general, the measurements are in excellent agreement with predictions of the standard model.

22834 (SSCL-SR–1225, pp. 63-71) **Recent results on B physics with CDF.** Mueller, J.A. (Rutgers Univ., Piscataway, NJ (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The existence of working b experiments at hadron colliders is a vital component in planning for CP violation studies in the B system. Not only do they extend current knowledge of the production and decay of the b quark, they reduce the amount of extrapolation necessary in making decisions for the future. As experimental and theoretical prejudices confront the reality of data, experimentalists obtain benchmarks with which to better design new experiments and upgrade existing ones. In May 1992, the drought of CDF data ended, as the Fermilab Tevatron resumed operations. This began what turned out to be a very successful year of running. Between the completion of detector commissioning and the end of the run, CDF wrote $\sim$ 21 pb^{-1} of data to tape. Analysis is proceeding rapidly, and already two papers on b physics have been submitted for publication. The author discusses the improvement made to CDF for the 1992 run, as well as gives a broad discription on how b events were triggered in CDF. He briefly reviews the results from the 1988 run on inclusive b production, with a little more detail on a study of $b\bar{b}$ correlated production. Then, he discusses a measurement of the differential cross section made using fully reconstructed B mesons from a portion of the new data. The addition of a silicon vertex detector has made the study of b lifetimes possible at CDF, and he discusses results on inclusive and exclusive measurements. Finally, he gives some indication of what, experimentalists hope, is yet to come from the data they have taken and will take in the coming year.

22835 (SSCL-SR–1225, pp. 73-81) **B physics at the D0 detector.** Cummings, M.A.C. (Univ. of Hawaii, Honolulu (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This article describes the current b physics program at the D0 experiment at Fermilab. Results from single and dimuon events

produced in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV include the inclusive muon and J/ψ differential cross sections and a measurement of the time-averaged B^0 - $\bar{B}^0$ mixing parameter χ. Plans for the near future b physics program at D0 are discussed, and an overview of the D0 upgrade, scheduled for implementation beginning with Fermilab collider run II are presented with emphasis on the prospects for continuing b physics research.

22836 (SSCL-SR–1225, pp. 83-96) **Extracting CKM parameters from B decays.** Dunietz, I. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This note extracts CKM (Cabibbo-Kobayashi-Maskawa) parameters from currently triggerable B-decay modes. The classic $B_d \to J/\psi K_S$ asymmetry measures the angle β, one of the angles of the CKM unitarity triangle. The other angles of that triangle are more difficult to extract. A tagged, time-dependent study of $B_s \to J/\psi\phi$ extracts the angle γ. Such a study of $B_d \to J/\psi\rho^0$ independently determines γ, where $B_d \to J/\psi K$ needs to be studied for normalization purposes. A tagged study of the classic $B_d \to \pi^+\pi^-$ extracts α if the penguin amplitude is negligible. The penguin may be sizable, however. An involved isospin analysis is then required. It measures α by disentangling the penguin from the tree amplitude. At hadron accelerators, this isospin analysis would require a tagged, time-dependent study of $B_d \to \pi^0\pi^0$, which is currently impossible. This note presents alternatives for measuring α. The angle could be obtained from studies of exclusive modes that are governed by $b \to d\ell^+\ell^-$, such as $B \to \rho\ell^+\ell^-$. The branching ratio for such an exclusive mode is tiny, at the few 10^{-8} level. Another method for measuring this angle require the study of both $B_d \to \pi^+\pi^-$ and $B_s \to K^+K^-$. Many more modes could be used to extract CKM parameters, if triggering on secondary vertices becomes feasible. The methods discussed here require high precision. They require tremendous effort experimentally and theoretically. Experiment will guide us toward the feasible modes and theory must accurately estimate ratios of related strong matrix elements.

22837 (SSCL-SR–1225, pp. 97-107) **B meson semileptonic decays from Υ(4S) resonance data.** Artuso, M. (Syracuse Univ., NY (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

B meson semileptonic decays are an exceptional laboratory to study a very important sector of the Standard Model, namely the quark mixing parametrized by the Cabibbo-Kobayashi-Maskawa (CKM) matrix. Two CKM elements are directly measured in semileptonic decays, ($|V_{ub}|$ and $|V_{cb}|$). In principle, another CKM element, ($|V_{tb}|$), can be extracted from measurements of $B^0\bar{B}^0$ mixing. A precise determination of quark mixing parameters is a crucial test of the Standard Model. Eventually, the determination of the complex phase in this mixing matrix, through measurement of CP asymmetries in B decays is likely to provide the most sensitive probe of possible physics beyond the Standard Model. However the measurement of the absolute values of these CKM elements already provide very interesting constraints and are important inputs in the prediction of the expected magnitude of these asymmetries.

22838 (SSCL-SR–1225, pp. 127-137) **B-physics in hadron colliders.** Hill, C.T. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A program of producing $> 10^{10}$ detectable B's is conservatively achievable within this decade. This offers an excellent conventional physics program of $\approx 10^9 B \to D^* \ell\nu$ decays and $\approx 10^5 B \to \rho\ell\nu$ decays, allowing a determination of $V_{cb} \pm 3\%$ and $V_{ub} \pm 20\%$. This also probes the quantities such as $\sqrt{B}(f_B)$ and f_{B_s} with high statistics. The resonances of the B-system and the prospects for flavor and kinematic tagging will emerge within the next few years. New states such as B_c will be surveyed, and the list of B_s and B_c decay modes will grow. CP-violation with conventional or bachelor pion tagging may be first observed in the ψK_S asymmetry within such a 10^{10} program. $B_S\bar{B}_S$ mixing looks difficult, though $x_s \lesssim 20$ may be probed. Rare and radiative dacays will be subject to their first probative examination.

22839 (SSCL-SR–1225, pp. 151-162) **Physics opportunities at asymmetric e^+e^- collider at** Y. Sakai, Yoshihide (National Laboratory for High Energy Physics, Ibaraki (Japan)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The prospects of various physics are discussed for an Asymmetric e^+e^- B-Factory, which is considered as a next project after TRISTAN at KEK. The potential reach of CP asymmetry measurements are presented for various decay modes based on the Monte Carlo simulation studies. Combining various decay modes, the angles in the unitarity triangle of the CKM-matrix could be measured with precisions of $\delta\sin 2\phi_1 \sim 0.05$, $\delta\sin 2\phi_2 \sim 0.07$, and $\delta\phi_3 \sim 13°$ with an integrated luminosity of 100 fb^{-1}.

22840 (SSCL-SR–1225, pp. 163-173) **Charm and beauty measurements at Fermilab fixed target.** Mishra, C.S. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Eighteen months after a successful run of the Fermilab fixed target program, interesting results from several experiments are available. This is the first time that more than one Fermilab fixed target experiment has reported the observation of beauty mesons. In this paper the author reviews recent results from charm and beauty fixed target experiments at Fermilab.

22841 (SSCL-SR–1225, pp. 209-212) **Fixed target B experiments and the angle alpha using $B^0 \to \pi\pi$ and $B^0 \to e_1\pi$.** McManus, A.P. (Univ. of Virginia, Charlottesville, VA (United States)); Cox, B.; Dukes, E.C.; Lawry, T. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Fixed target beauty (B) experiments proposed at the SSC or LHC come in two basic types. The first type is the extracted beam experiments using a bent crystal of silicon or some other method to extract a beam of protons parasitically from the circulating beam as the collider experiments are taking data. The two chief experiments proposing this method are the LHB collaboration which would use the LHC at CERN and the SFT collaboration which would use the SSC. The second type of fixed target experiment is one that would place the detector around the circulating beam using a gas jet or thin wire(s) as a target. Two experiments of this type are the one proposed at CERN for LHC (GAJET) and the Hera-B experiment proposed at DESY using the Hera collider.

22842 (SSCL-SR–1225, pp. 213-215) **Report on the α subgroup forward collider experiments.** Kwan, S. (Fermilab, Batavia, IL (United States)); Luk, K.B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The subgroup studied the potential of forward collider experiments for measuring the angle α using the $B^0 \rightarrow \pi^+\pi^-$ decay. In particular, they tried to answer the questions of what sensitivities the two different proposals (COBEX and forward BCD) could probe CP violation in the above decay mode in units of 10^7 seconds. A detailed comparison of the capabilities of the experiments would require extensive Monte Carlo estimates of the total number of reconstructed and tagged exclusive B meson decays as well as realistic estimates of the background. Both experiments have performed most of these calculations and their numbers have been used as the basis of discussion. Given the short time available in the workshop, the authors took the approach of examining the numbers presented by the proponents of the two experiments at the workshop and estimated what would be achievable.

22843 (SSCL-SR–1225, pp. 217-220) **Central collider experiments: A feasibility study of measuring the angle α with CDF.** Lewis, J.D. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Spalding, J.; Mueller, J.; Wilson, P. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The "central region" in hadron collider experiments is generally defined as the region $\eta < 1$ or 1.5, although "central experiments" certainly have some coverage well beyond this region. CDF and D0 at FNAL are principally high-p_T experiments, with an emphasis on this central region. Nevertheless they are capable of significant b physics and are upgrading their capabilities over an extended η region. The high-p_T experiments proposed for LHC and SSC again stress the central region. In this section the authors discuss the capabilities of the CDF detector at FNAL. In the central region, it is natural to use a solenoidal magnetic field with p_T as the relevant parameter for charged particle tracking. CDF has such a field. Solenoids are not ideal for tracking in the far forward direction (beyond $|\eta|$ of 2.5 or so), and the proposed forward experiments have dipole or quadrupole fields. The BCD proposals cover both central and forward region with a single dipole field. The principal issues for studying the angle α via the $\pi^+\pi^-$ decay mode are: triggering; background rejection; and tagging.

22844 (SSCL-SR–1225, pp. 221-225) **D0 upgrade: Feasibility study of measuring alpha by $B^0 \rightarrow \pi^+\pi^-$.** Mishra, C.S. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Lipton, R. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The upgrade plans of the Fermilab collider detectors opens the possibility of measuring CP violation in B decays. In this paper the authors discuss the planned D0 upgrade and present simulation results to explore the feasibility of measuring angle α of the CKM matrix using $B^0 \rightarrow \pi^+\pi^-$ decays.

22845 (SSCL-SR–1225, pp. 229-230) **Study of combinatorical background in the decay $B^0_d \rightarrow \pi^+\pi^-$ from p-p interactions at $\sqrt{s}$ = 40 TeV.** Long, O. (Univ. of Pennsylvania, Philadelphia, PA (United States)); Azfar, F.; Heinrich, J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The $b\bar{b}$ cross section at the SSC is predicted to be 1-3 mb, and 1-3% of the p-p interactions will produce a $b\bar{b}$ pair. Based on the experience of the CDF collaboration it has been established that the $B \rightarrow J/\psi X$ modes can be found with acceptable background levels in a hadron collider. This paper reports studies of the efficiency for reconstructing the decay $B^0_d \rightarrow \pi^+\pi^-$ and of rejection of background due to $b\bar{b}$. Identification of this decay mode is expected to be more difficult than the $B \rightarrow J/\psi X$ modes due to severe combinatoric backgrounds. Nonetheless, two aspects of B decays will make it possible to extract the $B^0_d \rightarrow \pi^+\pi^-$ signal at a hadron collider. The relatively long lifetime of the B meson allows the vertex for the decay $B^0_d \rightarrow \pi^+\pi^-$ to be easily isolated from the primary vertex. In addition, the pions from this decay have the maximum momentum of daughters from any B decay and so are more readily separated from low-P_T hadron backgrounds. The results reported here are based on detailed simulation of pattern recognition in vertex fitting using information from a silicon vertex detector. However, the separate issue of track pattern recognition is not addressed, and it is assumed that detector hits are all properly associated with tracks.

22846 (SSCL-SR–1225, pp. 231-232) **Background to $B_d \rightarrow \pi^+\pi^-$ from secondary interactions in a silicon microvertex detector at the SFT.** Lawry, T.J. (Univ. of Virginia, Charlottesville, VA (United States)); Dukes, E.C.; McManus, A.P. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The decay $B_d \rightarrow \pi^+\pi^-$ is very important for CP violation studies. The authors propose to study this decay using a Silicon Microvertex Detector (SMVD) at the SFT (SSC Fixed Target) experiment. The target region of the SMVD has 0.04 interaction lengths so that probability of secondary interaction is 2% per hadron from the primary vertex. These secondary interactions are a background to the decay $B_d \rightarrow \pi^+\pi^-$. This background is peculiar to the SFT since in collider, gas jet, and wire experiments the B_d decays take place in vacuum. In this note the authors show that the background from secondary interactions is negligible after simple kinematic cuts, at least for the channel $B_d \rightarrow \pi^+\pi^-$. The background could be further reduced, if necessary, by requiring that the production vertex of the $\pi^+\pi^-$ pair lie in one of the spaces between the silicon foils. The PHTHIA simulations were run with P^T_h = 0.7 GeV/c, rather than P^T_h = 0.35 GeV/c which is the PYTHIA default. P^T_h is the parameter which controls the transverse momentum of primary hadrons. The large value of P^T_h gives a much larger tail at high mass. The value of P^T_h = 0.7 GeV/c is probably much too large but they use it anyway to be conservative.

22847 (SSCL-SR–1225, pp. 233-235) **Vertex resolution in experiment 791.** Gounder, K. (Univ. of Mississippi, Oxford, MS (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG05-91ER40622. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The experiment E791 is fourth in the series of experiments using the Tagged Photon Spectrometer at Fermilab devoted to the study of production and decay of charm particles. During the 1991-1992 Fixed Target Run, it acquired an unprecedented 20 billion triggers (with a mild E-T trigger of about 4.5 GeV) with an expected reconstructed charm sample of over 200K decays. The components of the E791 version of the Tagged Photon Spectrometer along with the high speed parallel data acquisition system are described in detail elsewhere. Here, only the relavant elements for the detection of the primary interaction and the secondary charm decay vertices will be addressed.

22848 (SSCL-SR–1225, pp. 237-240) **Reconstruction of $B^0_d \rightarrow \pi^+\pi^-$ decays in the atlas experiment at LHC.** Gadomski, S. (Institute of Nuclear Physics, Cracow (Poland)); Eerola, P.; Ellis, N.; Froidevaux, D. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A study of the capability of the ATLAS experiment at the Large Hadron Collider to measure the CP-violation parameter α by using the decay channel $B^0_d \rightarrow \pi^+\pi^-$ is described.

22849 (SSCL-SR–1225, pp. 243-245) **Beta group summary.** DeJongh, F. (Fermilab, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators,

Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The angle β of the unitarity triangle can be measured through CP asymmetries in several decay modes. The most commonly considered decay mode in $B^0 \rightarrow J/\psi K_s$, $J/\psi \rightarrow$ ee, $\mu\mu$, and $K_s \rightarrow \pi^+\pi^-$. The dilepton in a secondary vertex provides a distinctive signature for triggering and reconstruction. Other modes in this class have a χ_c instead of a J/ψ, detected through $\chi_c \rightarrow J/\psi\gamma$. Also there are modes with a K^{*0} instead of a K_s, detected through $K^{*0} \rightarrow K_s\pi^0$. The consensus of the group was that detection efficiencies for the photons would not be high enough to make these modes useful. The study of b decays at hadron colliders has started at the Tevatron. There are still many steps to take to achieve a measurement of $\sin(2\beta)$. CDF and D0 have plans to take the next step in a program that may culminate in an initial measurement. An internal wire fixed target experiment in the HERA ring may also be able to measure $\sin(2\beta)$ with several years running. The large central detectors at SSC and LHC appear to have the ability to measure $\sin(2\beta)$ in one year of running at a luminosity one tenth of design. However, the dedicated forward and fixed target B detector proposals claim to have significantly better precision. At this workshop, while the authors gained much information about the various proposals, they were not able to evaluate which approach was the best.

22850 (SSCL-SR–1225, pp. 251-253) **Probing beta.** Kayser, B. (National Science Foundation, Washington, DC (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The angle β of the unitarity triangle may be measured by studying CP violation in the decay $B_d \rightarrow \psi + K^0_s$. However, to test the Standard Model (SM) of CP violation, one would like to do more than merely measure β. Rather, one would like to measure it in a variety of decay modes which differ at the quark level, but which, if the SM is correct, all yield this same angle. Do these different decay modes actually yield the same angle, as predicted. From the standpoint of testing the SM of CP violation, decay modes which are identical at the quark level may be considered to be equivalent, even if they involve different hadrons. Results on β from equivalent decay modes may be combined to improve the statistics. In this note the authors explained which B decay modes probe β, and identify several such modes which might be amendable to experimental study. Among these are modes which differ at the quark level, so that their results can be compared to test the SM, and ones which are identical at the quark level, so that their results can be combined to improve statistics.

22851 (SSCL-SR–1225, pp. 255-257) **A fixed target B experiment at the HERA proton ring.** Lohse, T. (MPI fuer Kernphysik, Heidelberg (Germany)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Amongst the multitude of proposed fixed target B experiments at proton machines, the HERA B detector is in several ways unique: Firstly, it is the only experiment for which the machine already exists and would be continously available with peak luminosity for many years. Secondly, it would have to operate at very low center of mass energies, slightly above 40 GeV, where the B cross section of 10 to 20 nb is 6 orders of magnitude smaller than that of normal inelastic events. It is therefore the first but also the most challenging fixed target B experiment dedicated to the phenomenon of CP violation. At the same time it has to be regarded as an ideal test-ground to gain experience for future more sophisticated experiments at the large machines. The project will be briefly described in this article.

22852 (SSCL-SR–1225, pp. 259-261) **Measuring the angle β in $B_d \rightarrow D^*D^*$ decays at the SFT.** Lawry, T.G. (Univ. of Virginia, Charlottesville, VA (United States)); Conetti, S.; Corti, G. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Even though the most popular reaction to measure the angle β is without any doubt the decay $B \rightarrow J/\psi K^0_s$, it would be extremely useful to achieve an independent measurement exploiting some different decay mode. It has been suggested that one possibility is given by the decays $B \rightarrow D\bar{D}$ or $B \rightarrow D^*\bar{D}^*$. In the following the authors discuss the capability of the SFT in reconstructing such decay modes; as discussed below, the live target environment is particularly suitable in recognizing the unique signatures of the modes under consideration. The $D^+\bar{D}^*$-mode is expected to have a larger branching ratio than $D\bar{D}$ and provides a more striking signature. The authors consider only the decay chain $B_d \rightarrow D^{*+}D^{*-}$, $D^{*\pm} \rightarrow \pi^{\pm}D^0$. They require one neutral D to decay to all charged tracks, they reconstruct the other D from the missing P_T and the D and D^* mass contraints.

22853 (SSCL-SR–1225, pp. 263-265) **Measurement of CP-violation with the GEM detector.** Yamamoto, Hiroaki (California Institute of Technology, Pasadena, CA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In this note, the feasibility of measuring CP-violation in the B-meson system with the GEM detector at SSC is described, using the decay mode $B_d \rightarrow J/\psi + K^0_S \rightarrow \mu^+\mu^-\pi^+\pi^-$ for the β angle measurement. In Section 2, the signature of the signal is discussed. Section 3 is devoted to a description of the GEM performance, including the estimation of the backgrounds. The rate of the signal is discussed in Section 4, and the summary is given in Section 5.

22854 (SSCL-SR–1225, pp. 267-270) **Prospects for measuring CP violation in SDC using $B^0_d \rightarrow \psi K_{0S}$.** Coupal, D.P. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This note describes results of a study of acceptance and backgrounds in the SDC detector for the neutral B meson decay $B^0_d \rightarrow \psi K^0_S$. The aim here is to explore the possibility of observing CP violation in the B system - a significant physics measurement that may be possible at the SSC during the period of time when the accelerator is ramping up to design luminosity. Section 2 describes the theoretical predictions for bb quark production at the SSC and the signal for CP violation in the B meson system. The following section outlines the cuts used to isolate $B^0_d \rightarrow \psi K^0_S$ decays and presents the expected rates for signal and background. The next section discusses the sensitivity to CP violation parameters and the final section contains some additional comments.

22855 (SSCL-SR–1225, pp. 271-274) **Reconstruction of $B^0_d \rightarrow J/\psi K^0_s$ decays in the atlas experiment at LHC.** Eerola, P. (CERN, Geneva (Switzerland)); Ellis, N.; Froidevaux, D.; Weinzierl, S. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A study of the feasibility for the ATLAS experiment at the Large Hadron Collider to measure the CP-violation parameter β by using the decay channel $B^0_d \rightarrow J/\psi K^0_s$ is described. Both time-integrated and time-dependent analysis are presented, and estimates on the sensitivities of the measurements are updated.

22856 (SSCL-SR–1225, pp. 275-277) **Measurement of $\sin(2\beta)$ with the CMS detector at LHC.** Neumeister, N. (Institut fuer Hochenergiephysik, Vienna (Austria)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO

(United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

For this study the author explored the possibility to determine CP-violation by measuring the time-integrated asymmetry in B^0_d, $\bar{B}^0_d \rightarrow J/\psi K^0_S$ decays, to determine the angle β of the unitarity triange. The time-independent asymmetry A for this channel is: $A = \sin(2\beta)(x_d/(1+x_d^2))$, where x_d has been measured to be 0.71. Because of the mixing phenomena, the nature of the B^0_d (particle or antiparticle) has to be determined. This can be done by measuring the charge of the $\mu^{\pm}$ in the semileptonic decay of the associated beauty hadron ($b \rightarrow \mu^- X$). The CMS (Compact Muon Solenoid) is designed as a general purpose detector for discoveries at the highest luminosity in proton-proton collisions at LHC. However, during the initial period of LHC operation, it is expected that there will be an opportunity to carry out heavy flavour studies, such as CP-violation, at lower luminosity. Here the author concentrates on the detector parts most important for measuring CP-violation, i.e. the muon-system, the muon trigger and the inner tracker.

22857 (SSCL-SR–1225, pp. 279-280) **K^0 finding efficiencies in increasing luminosities.** Hassard, J.F. (Imperical College, London (United Kingdom)); Margetides S. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

In early LHC running it is anticipated that experiments will obtain luminosities of 10^{32} $cm^{-2}sec^{-1}$, during which typically only one interaction per event will be obtained. But at higher luminosities, necessary for any Higgs and myriad other searches, experiments will have to deal with up to 50 distinct primary processes. Most will be minimum bias, and easily distinguished in terms of trigger. They can still, of course, confuse analysis of high P_T events. When it comes to B events, the confusion even from minimum bias events becomes more acute, since B events are not "high P_T" in this environment. The need for vertex discrimination, particularly in z, is well understood; however, a collateral effect - the increasing difficulty in finding tracks at all - has received little attention. The authors show the distribution of the K^0 in the Pythia process $B \rightarrow J/\psi K^0$ in the space γ vs. η. Confusion in reconstructing the K^0 is acute for many reasons, not the least of which is the way their pions are boosted forward, and even out of acceptance. Extra luminosity merely increases the problems in finding K^0's, so it must not be assumed that 10^{33} $cm^{-2}sec^{-1}$ is ten times better than 10^{32} $cm^{-2}sec^{-1}$.

22858 (SSCL-SR–1225, pp. 281-284) **A novel track finding technique for pp → bb̄ events.** Hassard, J.F. (Imperial College, London (United Kingdom)); Margetides, S. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Track finding techniques are in many senses a mature technology, with many highly effective working examples. This note describes in a preliminary way a novel method to be used in the LHC detector CMS. The authors have written trackfinder CMSTR for several reasons, among them: they wanted to develop a speedy method which would be suitable for highly parallel, probably online, hardwired VLSI treatment; they wanted to optimise for heavy quark decays in the CMS environment: that means decoupling the trackfinder from a known vertex, and reaching down to the relatively low $P_{T's}$ of 0.7 - 1 GeV/c, momenta characteristic of the pions from the K^0's in the decay $B \rightarrow J/\psi K^0$; they wanted to exploit - rather than be hurt by - the CMS tracker high magnetic field; they wanted to be relatively insensitive to misalignments between detector subcomponents; they wanted an algorithm which was robust enough to allow poin-free adaptation from the "Basic" design to the four or five options still being discussed: changes characteristic of an evolving detector.

22859 (SSCL-SR–1225, pp. 285-287) **Measurement of ratio of branching ratios.** Gonzalez-A, J. (Univ. of Pennsylvania, Philadelphia, PA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This paper reports a preliminary measurement of the ratio of branching ratios $BR(B^+ \rightarrow J/\psi K^+)/BR(B^0 \rightarrow J/\psi K^0)$. The reconstruction of J/ψ's is done via the decay $J/\psi \rightarrow \mu^+\mu^-$ while the K^0_s's are identified through the decay $K^0_s \rightarrow \pi^+\pi^-$. The data used was obtained at the Collider Detector at Fermilab from pp collisions at $\sqrt{s}$=1.8 TeV. There are several reasons why this measurement is important. It embodies the first observation of the decay mode $B^0 \rightarrow J/\psi K^0_s$ at a hadronic machine and it permits measurement of the ratio of charged to neutral lifetimes and the $BR(B^0 \rightarrow J/\psi K^0)$.

22860 (SSCL-SR–1225, pp. 291-297) **Measurement of the angle gamma.** Aleksan, R. (Centre d'Etude Nucleaire Saclay, Gif-sur-Yvette (France)); Kayser, B.; Sphicas, P. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The angle γ at least as defined in the Wolfenstein approximation is not completely out of reach of current or proposed dedicated B experiments. This conclusion certainly depends crucially on the assumed trigger and tagging efficiencies and also on the expected backgrounds. The work summarized here represents but a first step in the direction of extracting the third angle of the unitarity triangle. The theoretical developments during the workshop have resulted in a clearer understanding of the quantities studied. On the experimental side, new decay modes (i.e. in addition to the traditional ρK_s decay) have resulted in expections for observing CP violation in B_s decays which are not unreasonable. It is conceivable that a dedicated B experiment can probe a fundamental aspect of the Standard Model, the CKM matrix, in multiple ways. In the process, new physics can appear anywhere along the line.

22861 (SSCL-SR–1225, pp. 299-308) **In pursuit of gamma.** Aleksan, R. (DAPHNIA, Gif-sur-Yvette (France)); Kayser, B.; London, D. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

After reviewing techniques for extracting clean information on CP-violating phase angles from B decays, the authors explain the rules for finding decay modes that can probe the phase angle γ of the unitarity triangle. They identify the most promising of these "γ modes," estimate their branching ratios, and examine the degree to which they are theoretically clean. They then show that when the quark mixing matrix is not approximated as usual, but is treated exactly, none of the "γ modes" actually measures γ. Rather, each of them measures γ plus some correction. In all modes, the correction is small enough to be disregarded in first-generation experiments, but in some of them, it may be large enough to be observed in second-generation experiments. Their treatment of the γ modes calls attention to the fact that when the quark mixing matrix is treated exactly, there are six unitarity triangles, rather than just one triangle. However, only four of the angles in these six triangles are independent. Examining the role played by these four angles, they discover that, in principle at least, measurements of nothing by CP-violating asymmetries in B decays are sufficient to determine the entire quark mixing matrix.

22862 (SSCL-SR–1225, pp. 309-312) **Measuring γ with the decay $B^0_s \rightarrow D_s K$ and $B_u \rightarrow D^0 K$ with the CDF detector at the tevatron.** Blucher, E. (Univ. of Chicago, IL (United States)); Cunningham, J.; Kroll, J.; Snider, F.D.; Sphicas, P. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

This report summarizes a study of the sensitivity of the present CDF detector, with a trigger upgrade, to the following decay modes (and their charge conjugates) of the B_s and B_u mesons: $B_s^0 \rightarrow D_s^- K^+$ and $D^+_s K^-$; $B^+ \rightarrow \bar{D}^0 K^+$, $B^+ \rightarrow D^0 K^+$, and $B^+ \rightarrow D^0_{CP+} K^+$, where D_{CP+} refers to the even CP state $(|D^0\rangle + |\bar{D}^0\rangle)/\sqrt{2}$. These decays are of interest for measuring the angle γ, which is one of the three angles of the unitary triangle defined by $V_{ud}V^*_{ub} + V_{cd}V^*_{cb} + V_{td}V^*_{tb} = 0$. For this study, the authors use a b quark cross section of $\sigma = 20\mu b$ for $|\eta| < 1$ for $p\bar{p}$ collisions at $\sqrt{s} = 1.8$ TeV. They take a luminosity of 5×10^{31} $cm^{-2}s^{-1}$, which for a year of 10^7 seconds corresponds to an integrated luminosity of 0.5 fb^{-1}. This integrated luminosity yields 1.0×10^{10} b quarks per year in $|\eta| < 1$ (and 1.0×10^{10} $\bar{b}$ quarks). They assume that a b quark hadronizes into b hadrons in the following proportions: 37.5% $\bar{B}^0_d$, 37.5% B^-, 15% $\bar{B}^0_s$, and 10% b baryons.

22863 (SSCL-SR–1225, pp. 313-318) **Measurement of the angle gamma with a forward collider detector.** Karchin, P. (Yale Univ., New Haven, CT (United States)); Kennedy, C.; Harr, R.; Garren, L.; Avery, P.; Cords, D. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The γ group considered a variety of ways to directly or indirectly extract the angle γ. A representative sample of these methods was chosen for detailed evaluation by subgroups examining a specific detector or class of detectors. This subgroup considered the measurement of γ with a forward collider detector. The decay modes chosen for detailed study include: $B_s \rightarrow \psi\phi$; $B_s \rightarrow \rho K_s$; $B_s \rightarrow D_s^- K^+$; $B^+ \rightarrow D_1^0 K^+$. Note that decay modes of both B_s and B_u are considered. Some decay modes require flavor-tagging of the accompanying B while others are self-tagging. The theoretical basis for the various techniques are described in the published literature and/or in the proceeding of this workshop. The theoretical estimates for branching fractions which are used here were agreed upon as standards for the γ group. The analysis for sensitivity to the angle γ is straightforward for decays to a tagged CP eigenstate. For the other types of decays considered by the γ group, the determination of the error on γ is described in the report of the γ group. Here, the authors only report the total number of expected observed decays for these modes.

22864 (SSCL-SR–1225, pp. 319-322) **The measurement of the angle gamma in the SFT: An SSC fixed target B experiment.** Cox, B. (Univ. of Virginia, Charlottesville, VI (United States)); Corti, G.; Nelson, C.K.; Erwin, A. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The measurement of the gamma angle of the CKM triangle defined by the unitarity relationship $V_{ud}V^*_{ub} + V_{cd}V^*_{cb} + V_{td}V^*_{tb} = 0$ is difficult since most B decay modes only give direct access to this angle in the limit of the Wolfenstein approximation. In addition, even assuming this approximation is valid, determination of the gamma angle from many of the B decay modes requires measurements of the rapid oscillations of B^0_S decay distribution. Since the superior time resolution possible in fixed target experiments permits better measurements of mixing and time dependent CP violation effects in B_s decays than with other options, the SFT fixed target option is particularly suited for determination of the gamma angle.

22865 (SSCL-SR–1225, pp. 323-325) **The prospect for determining the angle γ in the decay $B^0_d \rightarrow \psi\rho^0$ at the SSC.** Bird, F. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The most compelling understanding of the evidence for CP violation in the neutral B meson system will require many redundant measurements of the angles of the unitarity triangle. The angle γ is presently considered to be the most difficult angle to measure. This is primarily due to mounting evidence that the mixing is almost complete in the neutral B_s system, which implies rapid oscillations between B_s^0 - $\bar{B}_s^0$ mesons. A large oscillation rate will preclude the experimental observation of the B_s mixing due to inadequate detector resolution, where the most optimistic designs promise to allow measurement to no better than $x_s \approx 25$. Due to this complication, alternative methods for extracting γ have been proposed. A candidate mode which has recently been proposed would require a study of the neutral B_d system in the $B^0_d \rightarrow \psi\rho^0$ decay mode. The measurement of the γ angle is via an asymmetry measurement as in the case of the β angle measurement. The theoretical motivation for the measurement is discussed here, followed by the experimental potential for such a measurement from one of the large high p_t detectors, SDC, proposed for the Superconducting Supercollider.

22866 (SSCL-SR–1225, pp. 331-332) **An overview of the δ working group.** Zieminski, A. (Indiana Univ., Bloomington, IN (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The δ group was charged to encompass all other b-physics topics not covered by the α, β and γ groups. It turned out to be quite a challenge. The convenors of the group: Y. Nir, S. Wojcicki and A. Zieminski decided that the topics discussed by the group should reflect the interests of the participants. With over 80 physicists, who signed up for this group, they were able to cover a large area of exciting physics. All topics were first presented at the group plenary sessions, and then the actual work was done by smaller working groups, with a well balanced input from both experimentalists and theorists. The δ group split into 3 major subgroups: (1) hadro- and photo- production, (2) B_s mixing, (3) B-decays plus a small subgroup dedicated to (4) other spectroscopy. The B-decays subgroup split even further into: (3.1) B_c spectroscopy and pentoquarks, (3.2) leptonic and semileptonic decays and (3.3) rare decays. The leaders and contributors to individual subgroups are listed at the end of this overview. There are 18 δ papers included in these proceedings. They summarize the majority of the topics discussed by the group and their order reflects the group organization described above.

22867 (SSCL-SR–1225, pp. 333-338) **B-quark production at hadron colliders.** Riemersma, S. (Southern Methodist Univ., Dallas, TX (United States)); Meng, R. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract W-31109-ENG-38. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Studying B-physics at hadron accelerators requires a good understanding of the total and differential cross sections for b-quark production. This knowledge gives those involved in $B\bar{B}$ mixing, rare B decays, and those trying to determine the CKM angles α, β, and γ an idea of how many events they can expect, given the luminosity and the branching ratios. It is particularly important for those studying rare B decays as they set limits on where one can hope to see new physics. For these reasons and others, the complete order(α^3_S) corrections to heavy-quark production at hadron accelerators were calculated. Also three groups have attempted to calculate heavy-quark production using resummation techniques in the small-x kinematic region. These resummation techniques are necessary since the b-quark mass m_b is small relative to the center-of-mass energies $\sqrt{S}$ of the Tevatron and the SSC. While these techniques offer some hope of obtaining reasonable predictions for b-production at these machines, the current results can best be considered as preliminary. Thus the authors must turn to fixed-order perturbative QCD for guidance, as there is no other real choice at this point. However, the authors submit a caveat here:

fixed-order perturbative QCD works best when all the scales are roughly comparable, i.e $\sqrt{s} \approx m_b \approx p_t$, $\sqrt{s}$ being the partonic center-of-mass energy. When not in this regime, for example at the Tevatron and the SSC, these predictions will then be less reliable.

22868 (SSCL-SR–1225, pp. 339-342) **Bottom quark cross sections at collider and fixed-target energies at the SSC and LHC.** Berger, E.L. (Argonne National Laboratory, IL (United States)); Meng, R. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract W-31109-ENG-38. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Calculations of inclusive cross sections for the production of bottom quarks in proton-proton collisions are presented as a function of energy, transverse momentum and Feynman x_F values of $\sqrt{s}$ from 100 GeV to 40 TeV. In addition, the authors provide simple parametrizations of their theoretical results that should facilitate estimates of rates, acceptances, and efficiencies of proposed new detectors.

22869 (SSCL-SR–1225, pp. 343-349) **Quarkonia production, b-quark production and $b\bar{b}$ correlation studies with CDF.** Papadimitriou, V. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The high rate of $B\bar{B}$ productions at the Tevatron makes it a unique place for the study of B production and decay. Although e^+e^- colliders provide a cleaner environment than hadron colliders for the study of B decays, CDF has shown that exclusive B channels can be successfully reconstructed in a harsh environment. The authors data have been taken in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV with the CDF detector during the 1988-89 and the 1992-93 collider runs. The CDF detector has been upgraded before the start of the 1992-1993 run. The upgrades relevant to this presentation are the muon chamber upgrade and the employment of a silicon vertex detector (SVX). The original CDF Central Muon detector, which covers the pseudorapidity region $|\eta| < 0.6$, has been complemented by the addition of four layers of drift tubes behind 2 feet of steel. As a result, hadronic punch-through backgrounds to the muon signal have been reduced by a factor of $\sim$ 10. There are also layers of drift tubes in the pseudorapidity region of $0.6 < |\eta| < 1.0$ in order to increase the muon coverage. Finally four layers of DC coupled, single sided, silicon detectors with R-ϕ readout have been added around the beam-pipe and provide a very good resolution in the transverse position of primary and secondary vertices. The primary vertex resolution in a typical event is 35 μm, similar to the transverse beam size. The impact parameter resolution is better than 40(15) μm for tracks with $P_T > 1$ (10) GeV/c. They have collected $\sim$21 pb^{-1} of data with this upgraded detector during the 1992-93 run.

22870 (SSCL-SR–1225, pp. 351-353) **B production at D0.** Choudhary, B.C. (Univ. of California, Riverside, CA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Preliminary results on B production using single and dimuon events produced in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV, are presented from the D0 experiment at FNAL. Results from inclusive muon and J/ψ studies are compared to the theory.

22871 (SSCL-SR–1225, pp. 389-393) **Semileptonic and leptonic decays of B hadrons.** Kinoshita, K. (Virginia Polytechnic Institute and State Univ., Blacksburg, VA (United States)); Amundson, J.; Dib, C.; Hou, G.W.S.; Jain, V.; Kronfeld, A.; Lebrun, P.; Oakes, R.J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Exclusive semileptonic and leptonic decays of B mesons are affected far less than hadronic decays by uncertainties due to strong interactions of quarks. As such, they are the modes of choice for measurement of the CKM matrix elements V_{cb} and V_{ub}. Nonetheless, past calculations of the decay widths have relied on phenomenological models such as the non-relativistic quark model and QCD sum rules to describe the behavior of the b and spectator quarks. The reliance on models can be lessened or eliminated by using heavy-quark symmetry arguments and/or lattice QCD. Both have made sufficient progress in recent years to kindle hope for smaller theoretical uncertainties for future determinations of CKM matrix elements. This optimism must be tempered by the experimental realities, as this comparison with theory will require the measurement of helicity-dependent form factors as a function of q^2. Interest is currently focused mainly on those decays for which prospects appear to be good, both for experimental measurement and theoretical certainty. The authors first list the modes and discuss the theoretical motivations. They then consider the prospects for experimental measurement of these modes, making projections five years into the future.

22872 (SSCL-SR–1225, pp. 395-403) **An overview of B rare decays.** Nir, Y. (Weizmann Institute of Science, Rehovot (Israel)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Hadron colliders are capable of investigating aspects of B physics where high statistics is a necessity and background is easily rejected. Among the "clean zeros" in CP asymmetries in B_s decays, the $B_s \to \psi\phi$ mode seems promising for hadron colliders. Among flavor changing decays with two final charged leptons, the $B \to K\mu^+\mu^-$ mode seems to be experimentally most feasible. For the observation of direct CP violation, the $B^- \to \psi K^-$ and $\Lambda_b \to pK^-$ modes seem promising. A detailed Monte Carlo investigation of these and other modes is well worth performing.

22873 (SSCL-SR–1225, pp. 417-425) **The search for flavor changing neutral currents in rare B decays.** Cline, D.B. (Univ. of California, Los Angeles, CA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The search for tree level FCNC with heavy flavors is sensitive to physics beyond the standard model. The authors discusses three types of FCNC experiments, (i) Precise study of $b \to s + \gamma$, (ii) Search for $B^0_s \to \tau^+\tau^-$, and (iii) $B \to \mu^+\mu^-X$. The author also comments on the UA1 limit for $B \to \mu\tilde{\mu}X$.

22874 (SSCL-SR–1225, pp. 427-431) **Simulation study $B \to X_s\gamma$.** Cline, D. (Univ. of California, Los Angeles, CA (United States)); Park, J.; Rhoades, J.; Atac, M. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A comprehensive study of charm and beauty decays is proposed in P867 as an extension of Fermilab experiment E771. Most of the decay modes studied for the proposal rely on the detection of a high p_t muon or high mass dimuon pair in the spectrometer. The addition of a Ring Imaging Cerenkov Counter, which is under consideration, would increase the number of decay modes accessible. No major upgrades are planned for the electromagnetic detector, but it may be possible to use the existing calorimeter to detect photons from rare beauty decays. As part of the ongoing simulation for P867, the authors have studied the decay $b \to s\gamma$. They expect several $\times 10^4$ such events to be produced, with about 10^3

satisfying the acceptance and trigger. The main problem in detecting the signal is that there is a very significant photon background. The simulations suggest that with good electromagnetic calorimetry and by optimizing cuts, adequate background suppression will be possible, and the signal will be detectable.

22875 (SSCL-SR–1225, pp. 455-456) **Probing the WWγ vertex in radiative b-quark decays.** Baur, U. (Florida State Univ., Tallahasee, FL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG05-87ER40319. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The recent CLEO results on radiative b-quark decays are used to derive constraints on anomalous WWγ couplings. These constraints are compared with expectations from $p\bar{p} \rightarrow e^{+-}p_T\gamma + X$ at the Tevatron. The usefulness is largely limited by present theoretical uncertainties in the calculation of hadronic matrix elements.

22876 (SSCL-SR–1225, pp. 459-460) **B Meson decay constants.** Oakes, R.J. (Northwestern Univ., Evanston, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG02-91ER40684. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The ratio of B meson decay constants F_{B_s}/F_{B_d} is shown to be very close to unity if the chiral symmetry of the Lagrangian is broken only by quark masses and the light quark flavor SU(3) is a good symmetry of the states.

22877 (SSCL-SR–1225, pp. 701-706) **Flavor identification of neutral B mesons using correlated pions.** Gronau, M. (Israel Institute of Technology, Haifa (Israel)); Rosner, J.L. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG02-90ER40560. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The authors have discussed the possibility of identifying neutral B mesons using hadrons produced nearby in phase space. The simplest example is the expected correlation between a B^0_d and a π^+, which they expect to be stronger (with relative probability P_1) than that between a B^0_d and a π^- (with relative probability $P_2 < P_1$). The correlation is expected to be most pronounced for low effective masses or small rapidity differences. It can exist as a result of resonances in the Bπ system, but can also be due simply to the fragmentation of a b quark. They give some estimates of the correlation factor $(P_1 - P_2)/(P_1 + P_2)$. The proposed tagging method is based on a statistical correlation. They have noted that time-dependent asymmetries, in neutral B decays to flavor-eigenstates, to CP-eigenstates and to other states from which CKM phases can be obtained, are diluted by the correlation factor $(P_1 - P_2)/(P_1 + P_2)$. As guidance for studies of this correlation one may look at the corresponding correlations involving D mesons. The authors have treated several issues regarding resonances, discussing some properties of the positive-parity charmed mesons and their extrapolation to B mesons, expected masses of 2S states, and the angular distribution in decays.

6624 Properties of Specific Particles and Resonances

Refer also to citation(s) 22793, 22806, 22821, 22832, 22839, 22865, 22938

22878 (BNL–60475) **Search for the presence of H particles in a neutral beam.** May, M. BNL-E888 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940725–2: International conference on hypernuclear and strange particle physics, Vancouver (Canada), 4-8 Jul 1994). Order Number DE94013526. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. POSTULATED PARTICLES/particle identification; FLAVOR MODEL; LEPTONIC DECAY

22879 (DOE/ER/40322–174) **The sharp lepton problem and the C(Q_o?) scenario.** Griffin, J.J. Maryland Univ., College Park, MD (United States). Dept. of Physics. Jan 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40322 ; FG02-93ER40762. (PP–93-127; CONF-9208218–1: Predeal International Summer School in Physics on topics in atomic and nuclear collisions, Predeal (Romania), 31 Aug - 11 sep 1992). Order Number DE93010521. Source: OSTI; NTIS; INIS; GPO Dep.

The Quadronium Conjecture and the Composite Particle (Q_o?) Scenario which it supports for the "(e^+e^-) Puzzle" are reviewed. They offer a place for every major qualitative feature observed so far. A new kind of "Supercomposite" molecule state is suggested in which the neutral polarizable composite particle is bound to nuclear ion, and predicts thereby four new, so far unobserved, decay modes. One, Sharp Annihilative Positron Emission, provides in its inverse process of Recoilless Positron Absorption a key to understanding the very sharp lepton lines observed to follow β^+ irradiation of heavy atoms. These emerge as just another aspect of the same C(Q_o?) scenario. Thus, the "(e^+e^-) Puzzle" is generalized into the expanded "Sharp Lepton Problem." This interpretation also implies from the β^+ data the first empirical upper bound upon the lifetime of the supercomposite state, $\tau_{MAX} \approx 10^{-17}$ sec, to be added to several other properties suggested by the scenario: a C(Q_o?) rest energy, $M_Cc^2 \sim 3mc^2$ ($\sim$ 1.5 meV), and level spacing $D_C \lesssim 100$ keV, both from the sharp (e^+e^-) lines' energies; and (for a Q_o composite of rest energy, $M_Qc^2 \approx 3mc^2$ ($\approx$ 1.5 MeV) with binding energy, $B_Q \sim mc^2$ ($\sim$ 0.5 MeV)): a radius roughly equal to the particle's own Compton wavelength, $R_Q \sim \lambda_c{}^Q \sim \hbar/3$ mc ($\sim$ 135 Fm), and a monopole stiffness, $k_Q \sim M_Q/R_Q{}^2$ ($\sim 10^{-4}$ MeV/Fm^2), both from model polarization studies of the heavy ion creation process. If the scenario comes to be accepted, as evidencing the actual physical existence of this leptonic composite particle, a further question would arise.

22880 (FNAL/C–94/088-E) **Electroweak and b-physics at the Tevatron collider.** Hara, K. (Tsukuba Univ., Ibaraki (Japan). Inst. of Physics). Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9403122–1: INS symposium, Tokyo (Japan), 8-10 Mar 1994). Order Number DE94013239. Source: OSTI; NTIS; INIS; GPO Dep.

The CDF and D0 experiments have collected integrated luminosities of 21 pb^{-1} and 16 pb^{-1}, respectively, in the 1992–1993 run (Run Ia) at the Fermilab Tevatron. Preliminary results on electroweak physics are reported from both experiments: the W mass, the leptonic branching ratios $\Gamma(W \rightarrow \ell\nu)$, the total W width, gauge boson couplings, W decay asymmetry and W'/Z' search. Preliminary new results on b physics are presented: $B^o - \bar{B}^o$ mixing from D0, and masses and lifetimes of B–mesons from CDF.

22881 (INIS-mf–13808, pp. 171) **New measurements on the electric polarizability of the neutron α_n.** Riehs, P. (Inst. fuer Kernphysik, Technische Univ. Vienna, Vienna (Austria)); Kopecky, S.; Harvey, J.A. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRONS/polarizability; ACCURACY; LEAD 208; NEUTRONS; POLARIZABILITY; RESEARCH PROGRAMS

22882 (INIS-mf–13808, pp. 172) **Experimental determination of the neutron-electron scattering length.** Kopecky, S. (Inst. fuer Kernphysik, Technische Univ. Vienna, Vienna (Austria)); Riehs, P.; Harvey, J.A.; Hill, N.W. Oesterreichische Physikalische

Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON-NEUTRON INTERACTIONS/ scattering lengths; LEAD 208

22883 (INIS-mf–13808, pp. 174) **Quantum chromodynamics and nuclear forces.** Rabitsch, K. (Inst. fuer Kernphysik, Technische Univ. Vienna, Vienna (Austria)); Markum, H.; Sakuler, W. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. GLUONS/exchange interactions; QUANTUM CHROMODYNAMICS/vacuum states; BARYON-BARYON INTERACTIONS; BARYONS; GLUONS

22884 (INIS-mf–13808, pp. 174) **Description of qq-bar bound states by an effective Schroedinger equation.** Lucha, W. (Oesterreichische Akademie der Wissenschaften, Vienna (Austria). Inst. fuer Hochenergiephysik); Moser, M.; Schoeberl, F.F. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. QUARK-ANTIQUARK INTERACTIONS/ bound state; EIGENVALUES; SCHROEDINGER EQUATION

22885 (JINR-E–1-93-443) **Study of strangeness production in relativistic nucleus beams at JINR.** Okonov, E.O. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 11p. Order Number DE94626720. Source: OSTI; NTIS (US Sales Only); INIS.

The talk given at the International Courses of the NATO advanced study institute 'Hot and Dense Nuclear Matter', Bodrum/Turkey, 26 Sep- 9 Oct, 1993.

The experimental data on strangeness production in nucleus-nucleus collisions at 3.4 - 3.7 A GeV are analyzed and compared with more recent results of BNL and CERN at higher energies. The main attention is given to remarkable changes in properties of produced Λ- and K-particles when a degree of the collision centrality increases: the flattening of their angular distributions up to nearly isotropic ones; the enhancement of the relative yields of Λ's with $P_T \geq 1$ GeV/c (i.e. beyond a background from N N-interactions) by a factor of about 10; the occurrence of a considerable portion of Λ's ($\approx 10\%$) with anomalously high P_T; the increase of Boltzmann temperatures $T_{\Lambda,K}$ from 75 MeV with approaching a plateau at $T_{\Lambda,K} \approx 160$ MeV, which corresponds to the inverse slope parameter $T_0 \simeq 200$ MeV and is near to the predicted critical temperature for the phase transition into quark-gluon plasma (QGP). The found effects confirmed by the data of BNL and CERN experiments, are expected as signals of a stopping, thermalization and heating of hadron matter with a formation of a hot and dense fireball/mixed phase via first order phase transition. Although more detailed studies and searches for alternative interpretations (beside QGP) are necessary to make a final conclusion, the considered results provide a strong evidence for a creation of a high excited fireball which is predicted to be a prolific source of strange objects formed. Programs of analyses are elaborated to examine anomalous events form central nucleus-nucleus collisions detected in streamer spectrometers, in order to look for light states of strange quark/ hypernuclear matter.

22886 (JINR-E–2-93-426) **Bohr's quantization rule in the world of resonances of elementary particles.** Gareev, F.A.; Ratis, Yu.L.; Strokovskij, E.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 16p. Order Number DE94626721. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Zeitchrift fuer Physik. C, Particles and Fields.

Quantization based on general quantum mechanical arguments is carried out for asymptotic values of momenta of decay products of hadronic resonances. Mass formula for hadronic resonances is obtained with making use of the above mentioned quantization conditions. Calculated spectra having a structure similar to that of the Balmer series are compared with the experimental data; the corresponding mass formula can be used for predictions of new possible resonances and their searches. (author.). 45 refs.; 2 figs.; 3 tabs.

22887 (SLAC-PUB–6502) **The form factors of the nucleons.** Schlumpf, F. Stanford Linear Accelerator Center, Menlo Park, CA (United States). May 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9405132–4: 14. international conference on few body problems in physics, Williamsburg, VA (United States), 26-31 May 1994). Order Number DE94013357. Source: OSTI; NTIS; INIS; GPO Dep.

The author demonstrates that a relativistic constituent quark model can give nucleon form factors that agree well with recent, accurate measurements. The relativistic features of the model and the specific form of the wave function are essential for the result.

22888 (SSCL-SR–1225, pp. 121-125) **B physics at LEP.** Kowalewski, R.V. (CERN, Geneva (Switzerland)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The experiments at LEP now dominate the world average b hadron lifetime, and have measured individual lifetimes for the pseudo-scalar B mesons and for b baryons with precisions of 15-20%. Measurements of the average mixing parameter [χ] at LEP suggest substantial B_s mixing. Flavor oscillations have been observed directly for the B_d, and searches for B_s oscillations are underway. Some exclusive B decays have been reconstructed, and the mass of the B_s has been measured. Most analyses are statistics limited, so further improvements can be expected as the data sample increases.

22889 (SSCL-SR–1225, pp. 361-365) **Prospects for measuring B_s mixing at CDF.** Skarha, J.E. (John Hopkins Univ., Baltimore, MD (United States)); Wicklund, A.B. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The original design of the Collider Detector at Fermilab (CDF) was optimized for high p_T physics measurements associated with W and Z boson, top quark, and QCD jet production. This choice resulted in an emphasis on the central pseudorapidity region ($|\eta| < 1.0$) for detector coverage. Thus, CDF has excellent tracking ($\Delta pT/pT = 0.0066 \oplus 0.0014pt$), good calorimetry, and a suitable muon system in the central region. Even with this limited coverage, the large $\bar{p}p \rightarrow bX$ cross section of nearly 100 μbarns for $|\eta| < 1.0$ has allowed the CDF experiment to make many B physics measurements. In addition, with the successful operation of the CDF silicon vertex detector (SVX), the capability for making time-dependent B_s mixing measurements becomes a reality. Upgrade plans, which include extending the tracking and lepton identification into the forward region and the implementation of a high-rate DAQ system, make a time-dependent B_s mixing measurement an attractive goal during the anticipated high-luminosity Main Injector collider runs. The authors discuss here the feasibility and potential of making a B_s mixing measurement based on extrapolations of the current CDF detector performance using colliding beam data and the expected upgrade plans.

22890 (SSCL-SR–1225, pp. 367-369) **Methodology for comparisons of B-mixing experiments.** Burnett, T.H. (Univ. of Washington, Seattle, WA (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO

(United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

An objective of this workshop was to provide a basis for comparison of the capabilities of different experiments, identifying the components entering into the comparison. A suggested framework was provided by the organizers in the form of a table that allows one to see the computations leading to the three primary elements in the determination of the resolution to be expected in the measurement of an asymmetry. These are: (1) N, the number of produced events; (2) ϵ, the total efficiency for detecting these events, such that ϵN is the number of events to be analyzed for the effect; and (3) $D \leq 1$, the total dilution factor reflecting a reduction of the effect to be expected due to the presence of background or mistagging. The effective number of events is further reduced to $\epsilon N D^2$. In B_x mixing, one wishes to measure the quantity $x_s=\Delta M/\Gamma$. An experiment observes two distributions, according to whether the charge conjugations of the B_s at production and decay are the same or different. Thus the experimental challenge is to assign the appropriate sign to each presumed B_s decay, and measure its proper time at the time of decay. An experiment must tag the charge conjugation of the B_s at creation, usually by identifying the recoil B; identify the nature of the B_s at decay; measure the distance between the two vertices; and measure the momentum of the B_s in order to determine the proper time.

22891 (SSCL-SR-1225, pp. 371-372) **Observability of mixing in partially reconstructed B_d and B_s at the SFT.** Lawry, T.J. (Univ. of Virginia, Charlottesville, VA (United States)); Conetti, S.; Corti, G.; Cox, B.; Dukes, E.C.; McManus, A.P.; Nelson, K.; Tzamouranis, I. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258--: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Observation of mixing ($B_d \rightarrow \bar{B}_d$ and $B_s \rightarrow \bar{B}_s$) is of great physical interest. Mixing is also experimentally challenging since it requires that the beauty particle be detected, that its particle-antiparticle nature be tagged both at production and decay, and that its lifetime in the rest frame be measured with high resolution. The authors propose to study mixing at the SSC Fixed Target experiment (SFT). In one year of running 1.6×10^{10} $B\bar{B}$ events will be produced. The branching ratio $B \rightarrow lX$, where l is a charged lepton, is 21% (for the average of B_d and B_u), and they assume B_s is the same. Assuming $B_u/B_d/B_s$ fractions 0.38/0.38/0.14, they get 2.0×10^8 $B_u \rightarrow lX$, $B_d \rightarrow lX$ events and 7.5×10^7 $B_u \rightarrow lX$, $B_s \rightarrow lX$ events. Their trigger efficiency for double semi-leptonic B events is 51%. They can afford to cut very hard on the data. Because of the high vertex resolution and long flight paths of the B, the distance the B travels in the lab is well measured ($L/\sigma L \approx 380$). The difficulty is to reconstruct the Lorentz $\Gamma = E_B/M_B$ since much of the energy of the B is in undetected neutral particles. They define the $M^{vis}{}_B$ and $E^{vis}{}_B$ to be the invariant mass and energy of all charged daughters of the B which fall inside the spectrometer angular acceptance of 2-75 mrad. They find that $\Gamma_{vis} = E^{vis}{}_B/M^{vis}{}_B$ gives a useful estimate of the true Γ since much of the effect of missing neutrals cancels in the ratio.

22892 (SSCL-SR-1225, pp. 373-376) **Prospects for $B^0{}_s$ $\overline{B^0}{}_s$ oscillation measurement at LEP.** Lou, XinChou (Indiana Univ., Bloomington, IN (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258--: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The measurements of $B^0{}_d\overline{B^0_d}$ mixing have provided direct constraint on the CKM matrix element $|V_{td}|$. Similarly, it is generally expected that a measurement of $B^0{}_s\overline{B^0_s}$ mixing will put strict constraint on $|V_{ts}|$ and the CKM unitary triangles. However data on average neutral B meson mixing at high energy e^+e^- and hadron colliders indicate a rapid $B^0{}_s\overline{B^0_s}$ oscillation. Therefore with knowledge of the time integrated $B^0{}_s\overline{B^0_s}$ mixing alone it is not sufficient to extract $|V_{ts}|$. The time dependent $B^0{}_s\overline{B^0_s}$ mixing must be directly measured. Direct observations of the decays of the B_s meson, the measurements of its lifetime and mass have been recently reported. At LEP the B_s meson can be effectively tagged via its semileptonic decays. The electric charge of a primary lepton tells if the decaying b meson is a $B^0{}_s$ or $\overline{B^0_s}$. Various techniques that identify the b quark flavour at $B^0{}_s$ production time (t=0) are being developed. The installation of silicon microvertex detectors at all four of the LEP experiments allows for precise determination of the $B^0{}_s$ decay vertex and subsequently the reconstruction of the $B^0{}_s$ decay proper time. All these make it possible for the LEP experiments to study the $B^0{}_s\overline{B^0_s}$ oscillation in the near future. The following sections describe the methods of B_s tagging at LEP, the techniques of b flavour (t=0) identification and the reconstruction of $B^0{}_s$ decay proper time. Finally a Monte Carlo study is presented on the sensitivity of the x_s measurement at LEP assuming a total of $4 \cdot 10^6$ hadronic Z^0 events will be collected per LEP detector at the end of LEP1.

22893 (SSCL-SR-1225, pp. 377-382) **B-$\bar{B}$ mixing in SLD.** Baltay, C. (Yale Univ., New Haven, CT (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258--: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The mixing of B^0 and $\bar{B}^0$ is one of the most important topics in B physics because the mixing occurs through second order weak box diagrams involving t to d and t to s quark transitions. The mixing parameters are thus sensitive to the CKM matrix elements V_{td} and V_{ts} which are presently difficult to assess experimentally in other ways. Mixing in the $B^0{}_d$ system has been observed in the ARGUS, CLEO and UA1 detectors. They measured the mixing integrated over time xd=mixed/(mixed + unmixed) = $(1/2)x^2{}_d/(1+(x_d)^2)$, and obtained a value of $x_d \sim 0.7$ where x_d is defined as Δ/Γ in the $B^0{}_d$ system. Since V_{ts} is expected to be larger than V_{td}, the authors expect the mixing to be substantially larger in the $B^0{}_s$ system. In this case, $\chi_s \rightarrow \frac{1}{2}$ and a time integrated mixing measurement is not very sensitive to x_s. It is thus imperative to measure the time dependence of $B^0{}_s$ mixing which is proportional to $\cos(x_s t)$ and is thus sensitive to x_s in the expected range of values. At this time there is a preliminary measurement from ALEPH of the time dependence of $B^0{}_d$ mixing, but there are no measurements of the time dependence of $B^0{}_s$ mixing. Such a measurement is one of the aims of an extended SLD program.

22894 (SSCL-SR-1225, pp. 383-385) **Measurement of B^0 - $\bar{B}^0$ mixing using dimuons at D0.** Johns, K. (Univ. of Arizona, Tucson, AZ (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258--: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

During the 1992-1993 collider run at the Fermilab Tevatron, the D0 detector was commissioned and collected 16.1 pb^{-1} of data which focused on high p_T physics such as top searches and electroweak measurements. The B physics accessible in the first run of D0 includes single, dimuon, and J/ψ production cross section measurements over a wide range of rapidity and the measurement of the combined B^0 - $\bar{B}^0$ mixing probability χ. Mixing between B^0 and its anti-particle can occur in the Standard Model via well-known box diagrams. The mixing parameters x_d and x_s are of interest because they can be written in terms of parameters of the Standard Model. In particular, x_d and x_s depend on the CKM matrix elements V_{td} and V_{ts}. An accurate measurement of χ can be used to set a lower limit on x_s, and thus help constrain elements of the CKM matrix.

22895 (SSCL-SR-1225, pp. 435-437) **Heavy flavor spectroscopy.** Rosen, J. (Northwestern Univ., Evanston, IL (United States)); Marques, J.; Spiegel, L. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258--: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B*

physics at hadron accelerators. 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

As a useful by-product of the unfolding searches for mixing and CP-violation effects in the beauty sector there will accrue very large data samples for the study of heavy flavor spectroscopy. (I) Hidden flavor states, i.e. $c\bar{c}$ and $b\bar{b}$ onium states. (II) Open flavor states (a) the D, D_s, B, B_s, and B_c meson systems; (b) Charm and beauty flavored baryons. In this brief note the authors emphasize that there are many missing (undiscovered) states in both categories - states which are not readily produced exclusively due to quantum number preferences or states which are not readily observed inclusively due to experimentally difficult decay channels. As recorded luminosities increase it may be possible to fill in some of the holes in the present listings of heavy flavor states. Of particular interest to the authors would be the identification of heavy flavor mesons which are not easily explained in terms of a $q\bar{q}$ paradigm but rather may be evidence for hadro-molecular status. At Snowmass 1993 the topic of self-tagging schemes in B meson production was very much in vogue. Whether or not excited B-meson flavor-tagging will prove to be competitive with traditional methods based on the partner B decay remains to be seen. The authors suggest however that the richness of the excited B-system may undetermine the efficacy of self-tagging schemes.

22896 (SSCL-SR–1225, pp. 439-441) **B_c.** Quigg, C. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract AC02-76CH03000. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

Mesons with beauty and charm are an interesting theoretical laboratory that should soon become accessible to experiment. One can predict the properties of $c\bar{b}$ states with confidence. In particular, the mass of the ground-state B_c is expected to lie close to 6356 MeV/c^2. More than a dozen narrow states lie below flavor threshold. They cascade to the ground state by making electromagnetic or hadronic transitions within the $c\bar{b}$ spectrum. The excited states are extraordinarily narrow. They may be observable in γ or $\pi\pi$ coincidences with B_c. Weak decays of B_c are affected by the strong binding of the $\bar{b}$ and c constituents. The authors estimates of the semi-inclusive decay rates lead to a lifetime $\tau(B_c) \approx 1.35 \pm 0.15$ ps that is appreciably longer than the guess $\tau(B_c) \approx (1/\tau_b + 1/\tau_c)^{-1} \approx 0.71$ to 0.88 ps, which neglects binding. The semi-inclusive analysis understates the important of B_s + light hadron modes. The author's best lifetime estimates is 1.1 to 1.2 ps. Finally, while B_c is an exotic - indeed, undiscovered - state today, it may have important practical applications in the future. The decay $B_c \rightarrow B_s \ell$ may provide a clean and efficient flavor tag for B_s.

22897 (SSCL-SR–1225, pp. 443-444) **B^{**} properties.** Quigg, C. (Fermi National Accelerator Laboratory, Batavia, IL (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

If significant numbers of B mesons are produced through one or more narrow excited $(\bar{b}q)$ states, the strong decay $B^{**\pm} \rightarrow B^{(*)0}\pi^{\pm}$ will tag the neutral meson as $(\bar{b}d)$ or $(b\bar{d})$, respectively. This might be dramatically more efficient than using the pair-produced partner of the B as a flavor tag, and could advance the search for the expected large CP-violating ambiguities in semileptonic decays of charged and neutral B mesons by choosing between two solutions for the momentum of the undetected neutrino. Estia Eichten, Chris Hill, and the author have used heavy-quark symmetry to estimate the masses, widths, and branching fractions of orbitally excited B, D_s, and B_s states from the properties of corresponding K and D levels. Their analysis shows that one requirement for the utility of B^{**}-tagging - narrow resonances - is likely to be met by the B_2^* and B_1. Experiment will have to rule on the strength of these lines and the ratio of signal to background.

22898 (SSCL-SR–1225, pp. 453-454) **PCAC relation for $D^* \rightarrow D$ axial form factors.** Dib, C.O. (Universidad Federico Santa Maria, Valparaiso (Chile)); Taron, J. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. DOE Contract FG02-91ER40690. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The spin-flavour symmetry among hadrons containing one heavy quark (b,c) and the chiral symmetry $SU(3)_L \times SU(3)_R$ associated with the light quarks (u,d,s), spontaneously broken down to $SU(3)_V$, can be invoked simultaneously to provide relations among matrix elements involving such heavy hadrons and soft Goldstone bosons (π, K, η). This treatment has recently been formulated under the form of an effective theory which incorporates the heavy quark and chiral symmetries at the same time. The effective lagrangian consists of an infinite number of terms, with an increasing number of derivatives, each of which is an expansion in inverse powers of the heavy quark masses. The coefficients of the different terms can not be fixed by symmetry arguments alone, and will be fitted from experiment.

22899 (SSCL-SR–1225, pp. 457-458) **Parton model (Moessbauer) sum rules for $b \rightarrow c$ decays.** Lipkin, H.J. (Weizmann Institute of Science, Rehovot (Israel)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The parton model is a starting point or zero-order approximation in many treatments. The author follows an approach previously used for the Moessbauer effect and shows how parton model sum rules derived for certain moments of the lepton energy spectrum in $b \rightarrow c$ semileptonic decays remain valid even when binding effects are included. The parton model appears as a 'semiclassical' model whose results for certain averages also hold (correspondence principle) in quantum mechanics. Algebraic techniques developed for the Moessbauer effect exploit simple features of the commutator between the weak current operator and the bound state Hamiltonian to find the appropriate sum rules and show the validity of the parton model in the classical limit, $\hbar \rightarrow 0$, where all commutators vanish.

22900 (SSCL-SR–1225, pp. 691-694) **Measurements of the $B^0\bar{B}^0$ CP asymmetry.** Lueth, V. (Superconducting Super Collider Laboratory, Dallas, TX (United States)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

A figure of merit for a measurement of CP violation is the error on the intrinsic asymmetry A_{CP}. The observed asymmetry A_{obs} will always be smaller than A_{CP} due to a number of effects that dilute the measurement. If one defines $A_{obs}=DA_{CP}$, where D represents the product of all dilution factors, then the error on A_{CP}, δA_{CP} is related to the number of produced B^0 or $\bar{B}^0$, N_{prod}, needed to obtain a given error on δA_{CP} by $N_{prod}=1/((\delta A_{CP})^2 D^2 \epsilon Br)$. To determine the figure of merit for a particular decay mode one must determine the number of reconstructed events N_{obs} and calculate the corresponding dilution factor D. N_{obs} depends on the luminosity and production cross section, on the branching ratio of the B^0 or $\bar{B}^0$ into the specific final state under study, Br, and on ϵ, the reconstruction efficiency for both the combination of the signal CP state and any tagging signal. The production rate N_{prod}, the dilution factor D, and the efficiency ϵ, differ substantially in magnitude as a function of energy and detector layout. The detection efficiency and dilution factor can both be written as a product of several factors that can be estimated for a particular experiment. These factors depend critically on the decay mode under study, the tagging method, the detector configuration, and more generally on the production process, backgrounds, and detector performance. Furthermore, the present knowledge of these quantities varies largely, as well as

ones ability to ultimately measure the dilution factor which relates the experimentally observed asymmetry to the true CP asymmetry.

22901 (SSCL-SR–1225, pp. 695-699) **Dilution measurements for CP violation in B decay.** Fridman, A. (CERN, Geneva (Switzerland)). Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The dilution effect appearing in the search for CP violation in the B^0_d, $\bar{B}^0_d$ decay is discussed. The authors considers pN collisions at large c.m. energy (LHC and SSC projects). A measurement of the dilution parameter is proposed by considering B^{+-}, B^0_d, $\bar{B}^0_d$ decaying into channels where CP violation is not present.

22902 (SSCL-SR–1225, pp. 713-723) **A super fixed target beauty experiment at the SSC.** Spiegel, L. (Fermi National Accelerator Laboratory, Batavia, IL (United States)); Murphy, C.T.; Cox, B.; Arenton, M.; Conetti, S.; Corti, G.; Dukes, C.; Golovatyuk, V.; Lawry, T.; McManus, A. Fermi National Accelerator Lab., Batavia, IL (United States). [1993]. (CONF-9306258–: Workshop on B physics at hadron accelerators, Snowmass, CO (United States), 21 Jun - 2 jul 1993). In *Proceedings of the workshop on B physics at hadron accelerators.* 765p. Order Number DE94007961. Source: OSTI; NTIS; INIS.

The observation and precision measurement of CP violation asymmetries and the phase of the CKM matrix is a major objective of B experiments at the SSC. The yields of reconstructed and tagged B decays and the various factors which minimize the dilution factors make measurements of CP asymmetries in the fixed target option known as the SFT more than competitive with much more expensive hadron collider experiments and significantly better than asymmetric e^+e^- B factories. Moreover, the superior time resolution possible in the SFT configuration allows a precision in the measurement of the CKM matrix element phases possible with the SFT option for various B decay modes.

6630 Nuclear Physics

Refer also to citation(s) 21715, 22753

22903 (INDC(NDS)–298) **Preparation of fusion benchmarks in electronic format for nuclear data validation studies: Summary report of the IAEA consultants' meeting held at the IAEA Headquarters, Vienna, Austria, 13 to 16 December 1993.** Ganesan, S. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1994. 22p. (CONF-931273–: IAEA consultants' meeting on preparation of fusion benchmarks in electric format for nuclear data validation studies, Vienna (Austria), 13-16 Dec 1993). Order Number DE94626725. Source: OSTI; NTIS (US Sales Only); INIS.

An IAEA Consultants Meeting on "Preparation of fusion benchmarks in electronic format for nuclear data validation studies" was convened by the International Atomic Energy Agency and held during December 13-16, 1993 at the IAEA Headquarters, Vienna. The main purpose of the meeting was to review the current status of work in the subject of compilation of fusion neutronic benchmarks for the purpose of integral validation of Fusion Evaluated Nuclear Data Libraries (FENDL working libraries). The compiled information in electronic format on fusion benchmarks will be used to integrally validate the working nuclear data libraries in processed form derived within the scope of the FENDL project of the Agency for neutron and photon transport. The detailed agenda, the complete list of participants and the recommendations of the Consultants Meeting are presented in this report. (author). 9 refs, tabs.

22904 (INDC(NDS)–299) **Preparation of processed nuclear data libraries for thermal, fast and fusion research and power reactor applications: Summary report of the IAEA consultants' meeting held at the IAEA Headquarters, Vienna, Austria, 8 to 10 December 1993.** Ganesan, S. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1994. 21p. (CONF-931273–: IAEA consultants' meeting on preparation of fusion benchmarks in electric format for nuclear data validation studies, Vienna (Austria), 13-16 Dec 1993). Order Number DE94626726. Source: OSTI; NTIS (US Sales Only); INIS.

A Consultants Meeting on "Preparation of Processed Nuclear Data Libraries for Thermal, Fast and Fusion Research and Power Reactor Applications" was convened by the International Atomic Energy Agency and held during December 13-16, 1993 December 8-10, 1993 at the IAEA Headquarters, Vienna. The detailed agenda, the complete list of participants and the recommendations are presented in this report. (author).

6631 Nuclear Structure

Refer also to citation(s) 22936, 22956

22905 (ANL/PHY/CP–79583) **Many-particle decays of α-chain structures in ^{24}Mg.** Wuosmaa, A.H. Argonne National Lab., IL (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930691–1: 20. international conference on atomic and nuclear clusters, Santorini (Greece), 28 Jun - 2 jul 1993). Order Number DE94012645. Source: OSTI; NTIS; INIS; GPO Dep.

We have searched for evidence of exotic cluster configurations in ^{24}Mg resembling a linear chain of α particles in various many-particle final states of the $^{12}C+^{12}C$ system, including $^{1}C(O_2^+)+^{12}C(O_2^+)$ and $^{8}Be+^{16}O^*(4a)$. Such configurations are predicted to occur by a number of different theoretical models of the structure of ^{24}Mg. An array of highly segmented Double-Sided Silicon Strip Detectors permits detailed, high resolution reconstruction of these many-charged-particle final states.

22906 (CONF-9305293–5) **Dynamical symmetry and truncation of the spherical shell model.** Guidry, M. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics). Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on nuclear structure physics today; Taiwan (China); 11-14 May 1993. Order Number DE94012757. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermion Dynamical Symmetry Model is used to introduce the idea of solving the shell model problem by means of symmetry-dictated truncation. Several calculations are presented suggesting that such truncations can lead to a model space in which a variety of nuclear structure phenomena are described economically using a simple effective interaction.

22907 (CONF-940183–2) **Simplified simulation of Boltzmann-Langevin equation.** Ayik, S. (Tennessee Technological Univ., Cookeville, TN (United States)); Randrup, J. Tennessee Technological Univ., Cookeville, TN (United States); Lawrence Berkeley Lab., CA (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER40530 ; AC03-76SF00098. From 22. gross properties of nuclei and nuclear excitations international workshop; Kleinwalsertal (Austria); 17-22 Jan 1994. Order Number DE94013541. Source: OSTI; NTIS; INIS; GPO Dep.

We briefly recall the Boltzmann-Langevin model of nuclear dynamics. We then summarize recent progress in deriving approximate analytical expressions for the associated transport coefficients and describe a numerical method for simulating the stochastic evolution of the phase-space density.

22908 (INIS-mf–13808, pp. 164) **Hadronic equation-of-state and pion propagator in the σ-ω model.** Baier, H. (Inst. fuer Radiumforschung und Kernphysik, Univ. Wien, Vienna (Austria)); Froehlich, N.; Pohl, P.; Hejc, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HADRONS/walecka model; PIONS/propagator; HADRONS; HARTREE-FOCK METHOD; NUCLEAR MATTER; PHASE DIAGRAMS; PIONS; PROPAGATOR

22909 (INIS-mf-13808, pp. 166) **Dynamical simulations of quark systems within a covariant transport approach.** Vetter, T. (Giessen Univ. (Germany). Inst. fuer Theoretische Physik); Biro, T.S.; Kalmbach, U.; Loh, S.; Mosel, U. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NUCLEON-NUCLEON INTERACTIONS/collisions; QUARKS/confinement; COMPUTERIZED SIMULATION; COLLISIONS; QUARKS; CONFINEMENT

22910 (INIS-RU–367, pp. 279-286) **K isomerism and collective dynamics of nucleus.** Pavlichenkov, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii). Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. 664p. (In Russian, English). (CONF-8910237–: International school seminar on heavy ion physics, Dubna (USSR), 3-12 Oct 1989). In *International School-Seminar on Heavy Ion Physics.* Order Number DE94612504. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ISOMERIC NUCLEI/high spin states; ISOMERIC NUCLEI/nuclear models; SUPERCONDUCTIVITY; VIBRATIONAL STATES

22911 (JINR-E–3-93-434) **Possibilities of determining the main peculiarities of γ-decay cascades in heavy nuclei.** Ali, M.A. (Atomic Energy Commission, Cairo (Egypt)); Khitrov, V.A.; Kholnov, Yu.N.; Popov, Yu.P.; Sukhovoj, A.M.; Vojnov, A.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 14p. Order Number DE94626734. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Journal of Physics. G, Nuclear Physics.

The main results of an analysis of the average parameters for γ-decay cascades of compound states in complex nuclei are presented. The experimental data of nuclear level densities, for certain J^{Π}, at excitation energies above 2 MeV are compared with that predicted by two different theoretical modes. Cascade intensities measured over the entire excitation energy range, from the ground state up to the neutron binding energy, are compared with different model predictions. Conclusion about the radiative partial width enhancements for transitions between the compound state and high lying excited states are given. The problems of estimating the actual temperature of excited nuclei, and of the experimental possibilities to observe phase transitions and their influence on γ-decay modes are discussed. (author.). 18 refs.; 12 figs.; 2 tabs.

22912 (JINR-E–4-93-417) **The thermo field transformation in the quasiparticle-phonon nuclear model.** Vdovin, A.I.; Kosov, D.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 10p. Order Number DE94626769. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya.

The method of extension of quasiparticle-phonon nuclear model to describe hot nuclei is proposed. For this aim the formalism of the thermo field dynamics is used. Following the main principles of the TFD we express the Hamiltonian of the QPM in terms of thermal quasiparticles. The coefficients of the corresponding transformation are determined by minimizing the grand thermodynamical potential of a hot nucleus in the thermal vacuum state. Then the RPA part of the thermal QPM Hamiltonian is extracted and the RPA equations are derived. They are in the agreement with the RPA equations derived by the Green function method and the equation of motion method. (author.). 15 refs.

22913 (LA-UR–94-1817) **A review of physics models in the LAHET™ code.** Prael, R.E. Los Alamos National Lab., NM (United States). [1994]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9405137–4: NEA/OECD specialists meeting on intermediate energy nuclear data codes, Paris (France), 30 May - 1 jun 1994). Order Number DE94013129. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the various physics options available in LAHET, including the Bertini and ISABEL intranuclear cascade models, the multistage, multistep preequilibrium exciton model, and the level density parameter options. The interdependence, the interaction with evaporation/fission models, and the sensitivity of results to the choice of options in shown. The particular options used in the code comparisons benchmark calculations are compared with the other options possible.

6632 Radioactivity and Electromagnetic Transitions (Excluding Fission)

Refer also to citation(s) 22910, 22916, 22972

22914 (CNIC–00706, pp. 16-18) **Decay of ^{54}V.** Chen Xueshi (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Nuclear Research); Zhu Jiabi; Xie Kuanzhong. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The radionuclide ^{54}V was produced by the fast neutron (n, p) reaction on a 50 mg sample of 90% isotopically enriched ^{54}Cr. The 14.6 MeV neutrons, the yield of which was 1.5 $\approx$ 2.0 x 10^9 neutrons/s, were generated through the T(d, n) reaction using the 200 kV Cockcroft-Walton accelerator. The average half life of ^{54}V is 46.4 +- 0.6 sec. Two new γ-rays with energies of about 4.56 and 5.0 MeV were discovered.

22915 (JINR-R–6-93-386) **Determination of decay energies of rare earths neutron deficient isotopes in the mass region A= 139 - 164.** Veselov, G.V. (Leningradskij Gosudarstvennyj Univ., Leningrad (Russian Federation)); Gromov, K.Ya.; Evtisov, S.V.; Eliseev, S.S.; Kalinnikov, V.G.; Kuznetsov, V.V.; Sehrehehtehr, Zh.; Fominykh, V.I.; Yuldashev, M.B.; Potempa, A.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1993. 40p. (In Russian). Order Number DE94626782. Source: OSTI; NTIS (US Sales Only); INIS.

Beta plus spectra end point energies are measured and decay energies for 25 short lived rare earths nuclides (A = 139 - 164, Z = 61 - 71) are determined on the ISOL (isotope separator on-line) facility YASNAPP-2 (mass separator on-line with 660 MeV proton beam). The technique for restoration of the initial form of positron spectra measured by the HPGe-detector has been developed. For 12 nuclides end points of positron spectra were measured for the first time. In other cases obtained data are in agreement with previous measurements.(author.). 22 refs.; 54 figs.; 1 tab.

6633 Nuclear Reactions and Scattering, General

Refer also to citation(s) 22878

22916 (CBPF-NF–040/92) **Nuclear fragmentation by nucleation approach.** Chung, K.C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1992. 21p. Order Number DE94626807. Source: OSTI; NTIS (US Sales Only); INIS.

The nucleation model is used to simulate nuclear fragmentation processes. The critical value of the effective interaction radius is shown to vary linearly with the expansion factor α. The calculated mass and charge distributions are compared with some experimental data. (author).

22917 (CNIC–00706) **Communication of nuclear data progress: No.8 (1992).** Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. 79p. (CNDC–0011; INDC(CPR)–029/L.). Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

Communication of nuclear data progress (CNDP) in English is set up by Chinese Nuclear Data Center (CNDC). This is the eighth issue. It includes the measurements of secondary neutron spectra on ^{9}Be, the cross section and angular distribution of ^{40}Ca(n, α)

reaction, ^{54}V decay data and $^{107}Ag(\alpha, n)$ cross section; the theoretical calculations of neutron induced reaction data on ^{56}Fe, ^{238}U and proton induced reaction data on ^{89}Y and ^{241}Am; the charged particle data evaluation of ^{235}U; and some papers on atomic and molecular data and data processing.

22918 (CNIC–00706, pp. 57-64) **Influence of nuclear deformed fluctuation on particle emission.** Wang Shunuan (Chinese Nuclear Data Center, IAE (China)). Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of nuclear deformed fluctuation on the double differential cross section and spectrum of emitted particles is studied in a stochastic framework in detail in the early time regime prior to fission events especially for medium heavy nuclei with very high fission barrier by solving a coupled master equation and Fokker-Planck equation.

6634 Specific Nuclear Reactions and Scattering

Refer also to citation(s) 21555, 22183, 22286, 22726, 22818, 22912, 22992, 23100

22919 (BNL–60244) **Stopping and Fermi/Bose effects in 14.6 A · GeV/c nucleus-nucleus collisions.** Parsons, C.G. (Niton Corp., Bedford, MA (United States)). E802 Collaboration; ANL-BNL-UCBerkeley-UCRiverside-Columbia-Hiroshima-INS-Kyushu-LLNL-MIT-NYU-Tokyo-Tsukuba. Brookhaven National Lab., Upton, NY (United States). [1994]. 17p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–18: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011739. Source: OSTI; NTIS; INIS; GPO Dep.

For central p+A and Si+A collisions, the average projectile baryon stopping has been determined. The average rapidity loss of the projectile baryons is 0.85 ± 0.1, 1.35 ± 0.1, 1.50 ± 0.28, 1.66 ± 0.21, 1.88 ± 0.17 and 2.11 ± 0.13 for Si+Al, Si+Au, p+Be, p+Al, p+Cu and p+Au, respectively. For central Si+Au collisions, significant deviations from exponential $M_\perp$ dependence of the differential cross-sections are found. Protons are suppressed at low $P_\perp$ and pions are enhanced relative to a simple exponential in $M_\perp$. This is ascribed to Fermi/Bose effects, and for pions the full (Y,pt) distributions can be well fit by a single source thermal distribution. Within errors both the temperature and chemical potential are equal to the pion mass. Pion densities of approximately 0.1 fm^{-3} for each species, or $\sim$0.3 fm^{-3} overall, are found if thermalization of the pions is assumed. This density corresponds to a hard sphere radius of 4.0 to 4.5 fm, in good agreement with pion and proton interferometry measurements.

22920 (BNL–60246) **Antiproton production in central Si+Au collisions at 14.6 A·GeV/c.** Rothschild, P.J. E802 Collaboration; ANL-BNL-UCBerkeley-UCRiverside-Columbia-Hiroshima-INS-Kyushu-LLNL-MIT-NYU-Tokyo-Tsukuba. Brookhaven National Lab., Upton, NY (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–17: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011727. Source: OSTI; NTIS; INIS; GPO Dep.

Antiproton measurements made by E802 have been extended to lower rapidities, while in those y-p_T regions already studied the statistics have been improved by approximately an order of magnitude. The author presents the dn/dy distribution for antiproton production in central 14.6 A·GeV/c Si+Au collisions in the rapidity range $0.8 < y < 1.8$. In addition, antilambda production has been detected for the first time in these collisions at the AGS.

22921 (BNL–60247) **What can we learn from $p_\perp$ spectra in heavy-ion collisions at the AGS?.** Cole, B.A. (Columbia Univ., New York, NY (United States)). E802 Collaboration; ANL-BNL-UCBerkeley-UCRiverside-Columbia-Hiroshima-INS-Kyushu-LLNL-MIT-NYU-Tokyo-Tsukuba. Brookhaven National Lab., Upton, NY (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–15: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011728. Source: OSTI; NTIS; INIS; GPO Dep.

Inclusive and semi-inclusive cross-sections for production of pions, kaons, and protons in Si+Al, Si+Cu, and Si+Au collisions, measured at the nucleon-nucleon center-of-mass rapidity are presented. The functional forms of the spectra are discussed. The centrality dependence of the inverse $m_\perp$ slopes is shown. Deviations in the spectra from pure exponential-$m_\perp$ distributions are discussed. The effects of resonance decays on the shape of the pion spectra are studied using previously measured p-p data, Si+Al data from E802, and the ARC model.

22922 (BNL–60248) **Target dependence of proton source sizes at 14.6 A · GeV/c.** Stephans, G.S.F. (Massachusetts Institute of Technology, Cambridge, MA (United States)). E859 Collaboration; ANL-BNL-UCBerkeley-UCRiverside-Columbia-Hiroshima-INS-Kyushu-LLNL-MIT-NYU-To Brookhaven National Lab., Upton, NY (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH00016 ; AC02-76ER03069 ; FG03-86ER40271 ; FG02-86ER40281 ; W-31109-ENG-38 ; W-7405-ENG-48. (CONF-930173–16: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011729. Source: OSTI; NTIS; INIS; GPO Dep.

Relative-momentum correlations have been measured for pairs of protons from central collisions of 14.6 A·GeV/c ^{28}Si with ^{27}Al, ^{107}Ag, and ^{197}Au nuclei. The protons were detected in a region centered near a laboratory rapidity of 1.2. Theoretical correlation functions are convoluted with the spectrometer response function and fitted to the data to derive the source volume. The fitted radii are corrected for small relativistic effects. The extracted volumes are consistent with a crude geometrical overlap model and depart from π - π and K-K data trends which suggest a source size closer to that of the projectile.

22923 (BNL–60249) **Kaon correlation systematics in E859.** Vossnack, O.E. (Columbia Univ., Nevis Labs., Irvington, NY (United States)). E802 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States);US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016. (CONF-930173–20: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011927. Source: OSTI; NTIS; INIS; GPO Dep.

Bose-Einstein correlations between K^+'s and between π^+'s produced in collisions of 14.6 A·GeV/c ^{28}Si ions and ^{197}Au nuclei have been measured using the E859 spectrometer. Parameters obtained from fits to correlation functions in relative momentum describe a K^+ source that is slightly smaller than the π^+ source and comparable in size to the ^{28}Si projectile. Correlation functions were also formed for πK^+ and pK^+ pairs extracted from the data set. Bose-Einstein correlations are expected to be absent here. The observed correlations can be understood as being the result primarily of the two-particle Coulomb interaction. For the pK^+ pairs, an adequate description is obtained only when taking into account the finite sizes of the p K^+ sources. The space-time coordinate distributions of pions and kaons produced by the event generator ARC for the 14.6 A·GeV/c ^{28}Si on ^{197}Au collision yield source sizes that are larger than those observed in the experiment. Much closer agreement is seen when viewing the distributions through a simulated version of the detector.

22924 (BNL–60250) **Multiplicity dependence of two-pion correlations.** Soltz, R.A. (Massachusetts Inst. of Tech., Cambridge, MA (United States)). E802 Collaboration. Brookhaven

National Lab., Upton, NY (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States);US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016. (CONF-930173–21: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011928. Source: OSTI; NTIS; INIS; GPO Dep.

Experiment E859 has measured two-pion correlations for 14.6 A·GeV/c ^{28}Si + Au and ^{28}Si + Al systems as a function of total charged particle multiplicity. The data have been divided into three multiplicity regions for each system, and fits to two-dimensional Gaussian sources have been performed. The extracted source parameters R_t and τ show little or no multiplicity dependence while the parameters R_t and R show a slight dependence. Two-pion correlations were also measured for the 11.6 A·GeV/c ^{197}Au + Au system as part of experiment E866. The rms radius (R_{rms}) for this system was found to be 7.03 $\pm$ 0.53 fm, consistent with a scaling of $R_{rms} = 1.2A_p^{1/3}$, where A_p is the number of projectile nucleons.

22925 (BNL–60251) **Comparison of oxygen and silicon induced reactions at 14.6 A·GeV/c.** Zachary, D.S. (Massachusetts Inst. of Tech., Cambridge, MA (United States)). E802 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States);National Aeronautics and Space Administration, Washington, DC (United States);US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016 ; AC03-76SF00098 ; W-7405-ENG-48 ; W-31109-ENG-38. (CONF-930173–19: HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE94011923. Source: OSTI; NTIS; INIS; GPO Dep.

Oxygen induced reactions have been studied with minimum bias as well as with central triggers. A recent comparison of pion production for ^{197}Au + Au ^{28}Si + Au central collisions has shown a possible $A^{2/3}$ dependance for the projectile and an $A^{1/3}$ dependance with the target nucleon number. We find for central ^{16}O + Au collisions that the pion yield dose similarly scale. The K/π ratio for central ^{16}O + Au reactions is .16 $\pm$ .01, very similar to the central K/π ratio for the ^{28}Si + Au reaction.

22926 (CNIC–00706, pp. 3-7) **The measurement of the beryllium secondary neutron spectra.** Zhang Kun (Institute of Nuclear Science and Technology of Sichuan Univ. (China)); Cao Jianhua; Wan Dairong; Dai Yunsheng. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The beryllium secondary neutron time-of-flight spectra induced by 14.7 MeV neutrons have been measured with an associated particle time of flight spectrometer at the laboratory angles of 15, 25, 35, 45, 60, 75, 90, 105, 120 and 135 degrees. The flight path of secondary neutrons is 254 cm. The bias is 0.9 MeV of the spectrometer and the time resolution is about 1.5 ns. The effective energy ranges is 1.0 MeV to 14.7 MeV for the secondary neutron spectra and the statistical error is 4 $\approx$ 10%.

22927 (CNIC–00706, pp. 7-15) **Measurement of cross section at 5 MeV and angular distribution at 4 and 5 MeV for reaction of ^{40}Ca(n, α)^{37}Ar.** Tang Guoyou (Beijing Univ., BJ (China)); Bao Shanglian; Qu Decheng. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The measurements of cross sections and angular distributions for ^{40}Ca(n, α) ^{37}Ar reaction were carried out with a gridded ion chamber. The detail introduction of the experimental set up were presented. The result of the cross section at 5 MeV was derived as $\sigma_{n,\alpha}$ 234 +- 23 mb. The α angular distribution at 4 and 5 MeV were shown out.

22928 (CNIC–00706, pp. 19) **Measurement of excitation functions for reactions ^{107}Ag(α, n)^{110m}In, ^{107}Ag(α,2n)^{109}In and ^{109}Ag(α,2n)^{111}In.** Peng Xiufeng (Institute of Nuclear Science and Technology, Sichuan Univ. (China)); Liu Mantian; He Fuqing; Long Xianguan. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The excitation function of reactions ^{107}Ag(α,n) ^{110m}In, ^{107}Ag(α,2n)^{109}In, and ^{109}Ag(α,2n)^{111}In have been determined. The irradiation of natural silver foil (purity better than 99.999%) with 26.8 MeV alpha beam was carried out at a 1.2 m cyclotron. The yield of the radioactive products was measured using a well calibrated HPGe detector. A computer system was adopted to acquire and analysis data.

22929 (CNIC–00706, pp. 20-34) **Calculation of neutron induced reaction on ^{56}Fe in energy region 5 $\approx$ 50 MeV with program CMUP2.** Shen Qingbiao (Chinese Nuclear Data Center, IAE (China)); Cai Chonghai. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

A set of neutron optical potential parameters for ^{56}Fe in energies of 5 $\approx$ 50 MeV is obtained based on the available experimental data. Various calculated nuclear data are in good agreement with the experimental data. Some conclusions on reaction mechanism were obtained.

22930 (CNIC–00706, pp. 35-41) **Comparison of direct inelastic scattering between coupled-channel theory and DWBA method calculations for ^{56}Fe and ^{238}U.** Shen Qingbiao (Chinese Nuclear Data Center, IAE (China)). Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The direct inelastic scattering cross sections and angular distributions of ^{56}Fe and ^{238}U at incident neutron energies 14.0 and 20.0 MeV were calculated by coupled-channel theory and DWBA method. The calculated results show: 1. For those nuclei, such as ^{56}Fe, coupling between the elastic and inelastic channels is weak, the DWBA method is a reasonable approximation. 2. For large deformation nuclei, such as ^{23}'8U, the DWBA method is not suitable and the coupled-channel theory needs to be used for calculating the direct inelastic scattering process. 3. The difference of the calculated results by two methods becomes little as incident neutron energy increases.

22931 (CNIC–00706, pp. 42-43) **The calculation of direct inelastic scattering cross section for n + ^{238}U.** Chen Zhenpeng (Qinghua Univ., Beijing, BJ (China). Dept. of Physics). Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The direct inelastic scattering cross section of neutron for n + ^{238}U were calculated with coupled-channel optical model. The calcination was proceeded continuously in 20 energies ranging from 0.005 MeV to 20 MeV. The output includes all the integrated and differential cross sections and Legendre coefficients. The further calculation which includes H-F modification has to be done.

22932 (CNIC–00706, pp. 44-52) **Calculation of proton induced reactions on ^{89}Y in E $\leq$ 40 MeV energy region.** Shen Qingbiao (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Zhao Wenrong; Cai Chonghai. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

A set of proton optical potential parameters for E $\leq$ 40 MeV was obtained based on the available experimental data of ^{89}Y and neighbour nucleus ^{90}Zr. The calculated nuclear data are in good agreement with the experimental data for some channels, for which there exist better measured values. The calculated radioisotope

yield cross sections show us which energy region is more suitable for specific radioisotope production in certain nuclear reaction.

22933 (CNIC–00706, pp. 52-56) **Calculation of various cross sections for p + ^{241}Am reaction in 5.5 ≈ 35 MeV energy region.** Shen Qingbiao (Chinese Nuclear Data Center, IAE (China)); Zhuang Youxiang. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The calculations of various cross sections for p + ^{241}Am reaction in 5.5 ≈ 35 MeV energy region were made with CFUP1 program. For (p, F) and (p, 2n) reactions, the calculated results agree with the available experimental data pretty well. The predicted cross sections have a significant reference value.

22934 (CNIC–00706, pp. 65-69) **The evaluations and theoretical calculations of ^{235}U(p,n)^{235}Np, ^{235}U(p,2n)^{234}Np and ^{235}U(d,2n)^{235}Np reaction cross sections.** Zhuang Youxiang (Chinese Nuclear Data Center, IAE (China)); Shen Qingbiao. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The theoretical calculations of excitation functions for ^{235}U(p,n) ^{235}Np and ^{235}U(p,2n) ^{234}Np reactions were presented. The results show that the trend of the theoretical calculation is reasonable. The evaluation of excitation function for ^{235}U(d, 2n)^{235}Np reaction was given. This excitation function was measured by ANL in 1959 and BRK in 1966, respectively.

22935 (CNIC–00730) **An unified program for calculating the fast neutron nuclear data for middle-heavy nuclei (MUP-III).** Yu Ziqiang (Nankai Univ., TJ (China)); Zhang Xiaocheng; Zhou Hongmo; Zuo Yixin; Wang Shunuan; Zhang Jishang; Shi Xiangjun. China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 6p. (NKU–0001.). Order Number DE94626822. Source: OSTI; NTIS (US Sales Only); INIS.

MUP-III program is used to calculate the fast neutron data of middle-heavy nuclei in energy range from 1 keV to 20 MeV. Its theoretical framework includes the optical model, width fluctuation corrected Hauser-Feshbach formula, evaporation model and pre-equilibrium statistical theory based on the generalized exciton model. MUP-III is designed by the module structure and adopts some new techniques to raise its running speed.

22936 (CNIC–00734) **The evaluation and theoretical calculation of the neutron reaction data for natural tin.** Yao Lishan (Shaanxi Teachers University, Xi'an (China)); Jin Yulin. China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 14p. (In Chinese). (SNU–0001.). Order Number DE94626823. Source: OSTI; NTIS (US Sales Only); INIS.

The evaluation of the neutron reaction cross section for natural tin measured by experiments have been completed. The interaction reaction data of the neutron with tin have been calculated by using the optical model (OPM), Hauser-Feshbach theory with width fluctuation correction (WHF) and evaporation model including pre-equilibrium emission (PEM) in the energy range of incident neutron between 1 to 20 MeV. The calculated results have been compared with the experimental data, and good agreement is obtained.

22937 (CONF-9308229–1) **Neutron multiplicities in spontaneous fission and nuclear structure studies.** Hamilton, J.H. (Vanderbilt Univ., Nashville, TN (United States). Dept. of Physics and Astronomy); Kormicki, J.; Lu, Q. Oak Ridge National Lab., TN (United States); Vanderbilt Univ., Nashville, TN (United States); EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; FG05-88ER40407 ; AC07-76ID01570. From Conference on frontier topics in nuclear physics; Predesl (Romania); Aug 1993. Order Number DE94012338. Source: OSTI; NTIS; INIS; GPO Dep.

New insights into the fission process can be gained by better quantitative knowledge of how the energy released in fission is distributed between the kinetic energy of the two fragments, the excitation energy of the two fragments and the number of neutrons emitted. Studies of prompt gamma-rays emitted in spontaneous fission (SF) with large arrays of Compton suppressed Ge detector arrays are providing new quantitative answers to longstanding questions concerning fission as well as new insights into the structure of neutron-rich nuclei. For the first time the triple gamma coincidence technique was employed in spontaneous fission studies. Studies of SF of ^{252}Cf and ^{242}Pu have been carried out. These γ-γ-γ data provide powerful ways to identify uniquely gamma rays from a particular nucleus in the very complex gamma-ray spectra given off by the over 100 different nuclei produced. The emphasis of this paper is on the first quantitative measurements of the multiplicities of the neutrons emitted in SF and the energy levels populated in the fragments. Indeed, in the break up into Mo-Ba pairs, we have identified for the first time fragments associated with from zero up to ten neutrons emitted and observed the excited energy states populated in these nuclei. The zero neutron emission pairs like ^{104}Mo- ^{148}Ba, ^{106}Mo- ^{146}Ba and ^{104}Zr- ^{148}Ce observed in this work are particularly interesting because they represent a type of cold fission or a new mode of cluster radioactivity as proposed by Greiner, Sandulescu and co-workers. These data provide new insights into the processes of cluster radioactivity and cold fission.

22938 (CONF-930999–11) **Boltzmann-Langevin transport model for heavy-ion collisions.** Ayik, S. (Tennessee Technological Univ., Cookeville, TN (United States)). Tennessee Technological Univ., Cookeville, TN (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER40530. From NATO Advanced Study Institute on hot and dense nuclear matter; Bodrum (Turkey); 26 Sep - 9 oct 1993. Order Number DE94013542. Source: OSTI; NTIS; INIS; GPO Dep.

Heavy-ion collisions at intermediate energies exhibit catastrophic phenomena which requires descriptions based on stochastic transport models. First, the Boltzmann-Langevin model, which provides an example of such stochastic approaches, is briefly described. Then, a projection method for obtaining numerical solutions of the Boltzmann-Langevin equation is discussed. Finally, some applications of the model to heavy-ion collisions are presented.

22939 (CONF-940169–6) **Results from CERN experiment WA80.** WA80 Collaboration. Oak Ridge National Lab., TN (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. winter workshop on nuclear dynamics; Snowbird, UT (United States); 15-21 Jan 1994. Order Number DE94013274. Source: OSTI; NTIS; INIS; GPO Dep.

Recent photon-measurement results are presented. Accurate reconstructed and π^0 and η results have been obtained down to signal/noise ratios of 0.002. The production of η mesons was found to be consistent with MT scaling observed in hadron-hadron collisions. "Direct," single-photon yields were extracted from high-statistics S+Au data obtained at 200 GeV/nucleon. A slight excess of photons over the number of photons that can be accounted for by hadronic decays was observed for central events. Two-proton correlations were obtained in the target fragmentation region in p+A, ^{16}O+A and ^{32}S+A reaction at 200 GeV/nucleon. Source radii extracted from the correlations were found to follow an $A^{1/3}$ dependence. This indicates that entire target nuclei are involved in the collisions and that a simple target-spectator picture does not apply at these energies.

22940 (DOE/ER/40637–8) **Relativistic heavy-ion collisions: 1993 annual report.** Hwa, R.C. Oregon Univ., Eugene, OR (United States). Inst. of Theoretical Science. 5 Nov 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-91ER40637. Order Number DE94010784. Source: OSTI; NTIS; INIS; GPO Dep.

This is a brief report on the work done last year from November 1992 to October 1993. Out of the various areas of research proposed for the three-year period 1993–96, we have successfully

carried out investigation in three topics: quark-hadron phase transition, hadron production, and multifractal structure. The results are summarized.

22941 (ENEA-RT-INN–93-11) **Coincidence-G Fortran Program: Calculation of Coincidence (e, e' x) cross sections and nuclear structure functions of closed shell nuclei in self-consistent HF-RPA continuum theory.** Marangoni, M. (ENEA, Bologna (Italy). Centro Ricerche Energia 'E. Clementel' - Area Energia e Innovazione); Saruis, A.M.; Giovanardi, N. ENEA, Bologna (Italy). Nov 1993. 94p. (RT/INN–93-11). Order Number DE94775226. Source: OSTI; NTIS (US Sales Only).

The double-coincidence cross-section for the scattering of polarized electrons on nuclei in the one photon exchange approximation can be expressed as the contraction of the leptonic and hadronic tensors and calculated in terms of five nuclear structure functions. This paper presents, after an introductory theoretical section, a Fortran Program for the calculation of the nuclear structure functions, differential cross-section, polarization asymmetry and some other useful angular distributions. The nuclear electromagnetic transition amplitudes are taken as input parameters and calculated in self-consistent HF-RPA theory with Skyrme forces.

22942 (GSI–93-55(prepr.)) **Particle production at SIS energies.** Wolf, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jul 1993. 61p. (CONF-9305314–: 2. two-arm photon spectrometer (TAPS) workshop, Guardamar (Spain), 31 May - 5 jun 1993). Order Number DE94774246. Source: OSTI; NTIS (US Sales Only); INIS.

We present a nonperturbative dynamical study of η-meson and pion production in heavy-ion collisions from 1 to 2 GeV/A bombarding energy. The dynamical evolution of the nucleus-nucleus collision is described by a transport equation of the Boltzmann-Uehling-Uhlenbeck type evolving phase-space distribution functions for nucleons, Δ's, N(1440)'s, N(1535)'s, pions and η's with their isospin degrees of freedom. Furthermore, we present results for differential dilepton yields in heavy-ion collisions at bombarding energies of 1 and 2 GeV/A incorporating all known sources for dilepton production. We investigate in particular the sensitivity of the calculated yields to predicted changes of the ρ meson in dense matter and discuss the feasibility to measure the time-like electromagnetic form factor of hadrons and their medium-dependence through the observation of dileptons. We present, finally, a calculation for the properties of ω meson in nuclear environment. (orig.)

22943 (INDC(NDS)–300) **Report on the second international activation calculation benchmark comparison study.** Cheng, E.T. (TSI Research Inc., Solana Beach, CA (United States)); Forrest, R.A.; Pashchenko, A.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1994. 23p. (TSIR–21.). Order Number DE94626824. Source: OSTI; NTIS (US Sales Only); INIS.

An activation comparison study was completed under the coordination of the IAEA Nuclear Data Section. It was participated by 11 regionally or internationally available computer codes developed principally for fusion reactor technology applications. A set of benchmark cross section and decay data libraries was established for all participating codes to use. Two calculations were performed for the respective targets, Cr-50 and natural iron, at a specified neutron spectrum at the first wall of a fusion reactor. The irradiation time was set for one year continuously for both cases. The results were compared and discussed. (author). 2 refs, figs and tabs.

22944 (INDC(SEC)–104) **WRENDA 93/94. World request list for nuclear data.** Kocherov, N.; McLaughlin, P.K. (eds.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1993. 125p. Order Number DE94626816. Source: OSTI; NTIS (US Sales Only); INIS.

Published on behalf of National Nuclear Data Centre, Brookhaven, USA (D. Larson, coord.); NEA Data Bank, Saclay, France (N. Tubbs, coord.); Nuclear Data Section, Vienna, Austria (N. Kocherov, coord.); Nuclear Data Center, Obninsk, Russia (B.D. Kuzminov, coord.).

WRENDA 93/94 is the tenth edition of the World Request List for Nuclear Data. This list is produced from a computer file of nuclear data requests, maintained by the Nuclear Data Section of the International Atomic Energy Agency (IAEA). The requests are provided by official bodies, such a national nuclear data committees, through four regional data centers serving all Member States of the IAEA. Each request included indicates: that the estimated accuracy of the nuclear data available does not satisfy the requirements encountered; and that, consequently, new data measurements and/or data evaluations with improved accuracy are highly desirable. WRENDA is intended to serve as a guide to experimentalists, evaluators and administrators when planning nuclear data measurement and evaluation programs. The requests in this edition come from six different countries and one international organization. (author).

22945 (INDC(SEC)–105) **Requests for fission yield measurements. A supplement to WRENDA 93/94 (published as INDC(SEC)-104).** Lammer, M. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1994. 27p. Order Number DE94626890. Source: OSTI; NTIS (US Sales Only); INIS.

Issued by participants of the IAEA Co-ordinated Research Programme on the Compilation and Evaluation of Fission Yield Nuclear Data.

The IAEA Co-ordinated Research Programme (CRP) on the Compilation and Evaluation of Fission Yield Nuclear Data has been established with the goal to improve the evaluation process, include the energy dependence of yields and full covariance information in the data base. The evaluation of experimental fission yield information is supplemented by semi-empirical model calculations. Measured fission yields are still insufficient to provide users with reliable data for the requested yield sets. Therefore, CRP participants elaborated and issued requests for further measurements: General requests, primarily for systematic studies, to help improving model parameters and evaluating the energy dependence of yields; tables of specific deficient yield data, where no or only one measurement exists, or where data are discrepant. (author).

22946 (INIS-BR–3333) **Average cross section measurements in U-235 fission neutron spectrum for some threshold reactions.** Maidana, N.L. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1993. 97p. (In Portuguese). Order Number DE94626825. Source: OSTI; NTIS (US Sales Only); INIS.

The average cross section in the ^{235}U fission spectrum has been measured by the activation technique, for the following thresholds reactions: ^{115}In(n,n')^{115m}In, ^{232}Th(n,f) P.F., ^{46,47,48}Ti(n,p)^{46,47,48}Sc, ^{55}Mn(n,2 n)^{54}Mn, ^{51}V(n,α)^{48}Sc, ^{90}Zr(n,2 n)^{89}Zr, ^{93}Nb(n,2 n)^{92m}Nb, ^{58}Ni(n,2 n)^{57}Ni, ^{24}Mg(n,p)^{24}Na, ^{56}Fe(n,p)^{56}Mn, ^{59}Co(n,α)^{56}Mn and ^{63}Cu(n,α)^{60}Co. The activation foils were irradiated close ($\approx$ 4 mm) to the core of the IEA-R1 research reactor in the IPEN-CNEN/SP. The reactor was operated at 2 MW yielding a fast neutron flux around 5×10^{12} n.cm^{-2}. s^{-1}. The neutron flux density was monitored by activation reactions with well known averaged cross sections and with effective thresholds above 1 MeV. The foil activities were measured in a calibrated HPGe spectrometer. The neutron spectrum has been calculated using the SAIPS unfolding system applied to the activation data. A detailed error analysis was performed using the covariance matrix methodology. The results were compared with those from other authors. (author).

22947 (INIS-mf–13808, pp. 48) **Scattering of 14 MeV neutrons on natural sodium.** Priller, A. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Steier, P.; Vonach, H.; Winkler, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRON REACTIONS/inelastic scattering; SODIUM/neutron reactions; DIFFERENTIAL CROSS SECTIONS; MEV RANGE 10-100; SODIUM

22948 (INIS-mf–13808, pp. 49) **Measurement of elastic and inelastic scattering cross-sections of 14 MeV neutrons on lead.** Steier, P. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Priller, A.; Vonach, H.; Winkler, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. LEAD/neutron reactions; NEUTRON REACTIONS/elastic scattering; NEUTRON REACTIONS/inelastic scattering; DIFFERENTIAL CROSS SECTIONS; LEAD; MEV RANGE 10-100

22949 (INIS-mf–13808, pp. 168) **Investigations of the ^{58}Ni(n,α) reaction.** Goverdovski, A. (IPPE Obninsk (Russian Federation)); Khryachkov, V.; Vonach, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NICKEL 58 TARGET/neutron reactions; ALPHA PARTICLES; ANGULAR DISTRIBUTION; ENERGY SPECTRA; MEV RANGE 01-10

22950 (INIS-mf–13808, pp. 169) **High-resolution (n,xγ) measurements on ^{27}Al.** Hitzenberger, H. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Vonach, H.; Pavlik, A.; Nelson, R.O.; Haight, R.C.; Wender, S.A. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ALUMINIUM 27 TARGET/neutron reactions; DIFFERENTIAL CROSS SECTIONS; GAMMA RADIATION; MEV RANGE 01-10; MEV RANGE 10-100; MEV RANGE 100-1000

22951 (INIS-mf–13808, pp. 169) **Atom influence on the ^{8}Be resonance in α-α scattering.** Gruen, K. (Inst. fuer Kernphysik, Technische Univ. Wien, Vienna (Austria)); Huber, H.; Leeb, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. Jahrestagung der Oesterreichischen Physikalischen Gesellschaft, Technische Universitaet Graz, 20.-24. September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ALPHA REACTIONS/resonance scattering; BERYLLIUM 8 TARGET/alpha reactions; ALPHA PARTICLES; KEV RANGE 100-1000; MATHEMATICAL MODELS

22952 (INIS-mf–13808, pp. 170) **Direct radiation capture of neutrons on nuclei with low level density.** Huber, H. (Inst. fuer Kernphysik, Technische Univ. Wien, Vienna (Austria)); Krauss, H.; Krausmann, E.; Oberhummer, H.; Rauscher, T.; Boehmer, W.; Kratz, K.L.; Woehr, A.; Thielemann, F.K. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. MAGIC NUCLEI/neutron reactions; NEUTRON REACTIONS/capture; NEUTRON-RICH ISOTOPES/neutron reactions; CROSS SECTIONS; CAPTURE; REACTION KINETICS

22953 (INIS-mf–13808, pp. 171) **Capture reactions at thermonuclear energies.** Koelle, V. (Tuebingen Univ. (Germany). Physikalisches Inst.); Luessern, G.; Mohr, P.; Wilmes, S.; Staudt, G.; Hammer, J.W.; Oberhummer, H.; Krauss, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. DEUTERIUM TARGET/alpha reactions; HELIUM 3 REACTIONS/capture; HELIUM 3 TARGET/alpha reactions; LITHIUM 6 TARGET/proton reactions; TRITIUM TARGET/alpha reactions; BERYLLIUM 7; EXCITATION FUNCTIONS; FLUORINE 19; GAMMA RADIATION; CAPTURE; KEV RANGE 100-1000; LITHIUM 6; LITHIUM 7; MEV RANGE 01-10; NITROGEN 15 TARGET; POTENTIALS

22954 (INIS-mf–13808, pp. 175) **Investigations of the (n,xnγ) reactions on ^{207,208}Pb for neutron energies up to 200 MeV.** Pavlik, A. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Vonach, H.; Nelson, R.O.; Wender, S.A.; Young, P.G.; Haight, R.C.; Chadwick, M.B. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. LEAD 207 TARGET/neutron reactions; LEAD 208 TARGET/neutron reactions; NEUTRON REACTIONS/particle production; CROSS SECTIONS; ENERGY DEPENDENCE; GAMMA RADIATION; GAMMA SPECTRA; LEAD 200; LEAD 202; LEAD 204; LEAD 206; MEV RANGE 01-10; MEV RANGE 10-100; MEV RANGE 100-1000; NEUTRONS; NUCLEAR MODELS

22955 (INIS-mf–13808, pp. 176) **Scattering of 14 MeV neutrons on natural sodium.** Priller, A. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Steier, P.; Vonach, H.; Winkler, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRON REACTIONS/inelastic scattering; SODIUM/neutron reactions; DIFFERENTIAL CROSS SECTIONS; MEV RANGE 10-100; SODIUM

22956 (INIS-mf–13808, pp. 179) **Model calculations of neutron-induced reactions on ^{23}Na up to 20 MeV primary energy.** Strohmaier, B. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik). Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SODIUM 23 TARGET/neutron reactions; CROSS SECTIONS; OPTICAL MODELS

22957 (INIS-mf–13808, pp. 179) **Determination of nuclear energy levels from analysis of neutron production spectra from proton-induced reactions on ^{204,206,207,208}Pb and ^{209}Bi.** Wallner, A. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Strohmaier, B.; Vonach, H. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. BISMUTH 209 TARGET/energy levels; BISMUTH 209 TARGET/neutron reactions; LEAD 204 TARGET/energy levels; LEAD 204 TARGET/neutron reactions; LEAD 206 TARGET/energy levels; LEAD 206 TARGET/neutron reactions; LEAD 207 TARGET/energy levels; LEAD 207 TARGET/neutron reactions; LEAD 208 TARGET/energy levels; LEAD 208 TARGET/

neutron reactions; NEUTRON REACTIONS/particle production; NEUTRON SPECTRA; NEUTRONS; NUCLEAR MODELS

22958 (INIS-RU–367, pp. 237-252) **Delay fission phenomenon in excited actinide nuclei.** Platonov, S.Yu. (Moskovskij Gosudarstvennyj Univ., Moscow (Russian Federation). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki); Fotina, O.V.; Yuminov, O.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. 664p. (In Russian, English). (CONF-8910237–: International school seminar on heavy ion physics, Dubna (USSR), 3-12 Oct 1989). In *International School-Seminar on Heavy Ion Physics.* Order Number DE94612504. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEPTUNIUM ISOTOPES/beta decay; NEPTUNIUM ISOTOPES/fission; PROTACTINIUM ISOTOPES/beta decay; PROTACTINIUM ISOTOPES/fission; CROSS SECTIONS; DEUTERON REACTIONS; EXPERIMENTAL DATA; FISSION; NEUTRONS; NUCLEAR DEFORMATION; NUCLEAR REACTION YIELD

22959 (INIS-RU–367, pp. 253-267) **Kandom neck rupture.** Brosa, U. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. 664p. (In Russian, English). (CONF-8910237–: International school seminar on heavy ion physics, Dubna (USSR), 3-12 Oct 1989). In *International School-Seminar on Heavy Ion Physics.* Order Number DE94612504. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. DEEP INELASTIC HEAVY ION REACTIONS/nuclear models; QUASI-FISSION/nuclear models; TERNARY FISSION/nuclear models; CROSS SECTIONS; EXPERIMENTAL DATA; FISSION YIELD; MULTIPLICITY; NEUTRONS; PROBABILITY; QUASI-FISSION; THEORETICAL DATA

22960 (JAERI-M–93-046, pp. 72-81) **Integral spallation experiment with a lead assembly irradiated with 500 MeV protons: Nuclear data in medium energy region.** Takada, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hasegawa, K.; Sasa, T.; Meigo, S.; Kanno, I. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. (CONF-9211225–: 1992 symposium on nuclear data, Tokai (Japan), 26-27 Nov 1992; INDC(JPN)–163/L). In *Proceedings of the 1992 symposium on nuclear data.* 393p. Order Number DE93012393. Source: OSTI; NTIS; INIS.

An integral spallation experiment with a lead assembly was performed using 500 MeV protons. Lead and tungsten were employed as target in the assembly. The spatial distribution of the nuclide yields was obtained by the use of the activation method. It was found from the measured data that the number of the high energy neutrons in deep position in the assembly was smaller for tungsten target than for lead target. A calculation was made with the nucleon meson transport code NMTC/JAERI. The calculated results reproduced the spatial distribution of the nuclide yield well except for the one in the deep position on the axis. (author).

22961 (JAERI-M–93-046, pp. 82-91) **Neutron measurement for (p, Xn) reaction with protons of GeV range: Nuclear data in medium energy region.** Ishibashi, Kenji (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering); Nakamoto, Tatsushi; Matsufuji, Naruhiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. (CONF-9211225–: 1992 symposium on nuclear data, Tokai (Japan), 26-27 Nov 1992; INDC(JPN)–163/L). In *Proceedings of the 1992 symposium on nuclear data.* 393p. Order Number DE93012393. Source: OSTI; NTIS; INIS.

The neutron-emission cross sections were measured by the time-of-flight method at National Laboratory for High Energy Physics (KEK). The experiment was carried out with targets of C and Pb at incident proton energies of 0.8, 1.5 and 3.0 GeV. The preliminary data analysis was made, and the double differential cross section for Pb at 0.8 GeV was consistent with the data of a different laboratory. The measurement is planned to be continued with targets of Al, Fe and In. (author).

22962 (JAERI-M–94-009) **Evaluation of nuclear data of ^{237}U, ^{236}Np and ^{238}Np.** Nakagawa, Tsuneo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kikuchi, Yasuyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 64p. (In Japanese). Order Number DE94770611. Source: OSTI; NTIS; INIS.

Nuclear data evaluation for ^{237}U, ^{236}Np and ^{238}Np was made in the neutron energy range from 10^{-5} eV to 20 MeV. Quantities evaluated are the total, elastic and inelastic scattering, capture, fission, (n,2n) and (n,3n) reaction cross sections, the angular and energy distributions of secondary neutrons, and the number of neutrons emitted per fission. Since experimental data are very scarce for these nuclides, the evaluation was made on the basis of optical and statistical model calculations, and systematics of data. Results were complied in ENDF format. (author).

22963 (JAERI-M–94-011) **Elastic and inelastic scattering of protons from Oxygen-16.** Koori, Norihiko (Tokushima Univ. (Japan)); Watanabe, Yukinobu; Hane, Hiroki. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1994. 61p. (INDC(JPN)–168/L). Order Number DE94770635. Source: OSTI; NTIS; INIS.

Double differential cross sections of the ^{16}O(p, p'x) reaction and differential cross sections and analyzing powers of polarized proton elastic and inelastic scattering were measured at 14 and 16 MeV. The optical potential parameter set, which was derived for ^{16}O from the spherical optical model analysis, reproduces the elastic scattering data fairly well. Large differences are found in the potential depths of the imaginary and spin-orbit terms between 14 and 16 MeV. This may be due to strong resonance structure in the compound nucleus of ^{17}F. (author).

22964 (JINR-E–1-93-419) **Characteristics of gamma-quanta emission process in Π^- + Xe nuclear collisions at 3.5 GeV/c momentum.** Strugalski, Z. (Warsaw Univ. (Poland)); Mulas, E.; Dessoky, A.; Strugalska-Gola, E. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 8p. Order Number DE94626887. Source: OSTI; NTIS (US Sales Only); INIS.

Characteristics of the gamma-quanta emission process: emission intensity, energy and momentum spectra, and angular distributions have been obtained experimentally in almost total experiment performed by means of the 180 litre xenon bubble chamber exposed to 3.5 GeV/c momentum negatively charged pion beams. The dependence of the characteristics on the internuclear matter layer thickness involved in the collisions is evidently observed. Comparisons between the characteristics of the emitted quanta and the corresponding characteristics of the parent neutral pions are performed. (author.). 6 refs.; 5 figs.; 3 tabs.

22965 (JINR-E–2-93-397) **The process ^{3} He + p ->^{4} He = π^+ on the polarized hydrogen target as an analyzer of the ^{3} He polarization.** Lyuboshits, V.L. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1993. 6p. Order Number DE94626836. Source: OSTI; NTIS (US Sales Only); INIS.

Report at International Symposium 'Dubna, Deuteron-93', 14-18 Sep, 1993.

The cross section dependence of the process ^{3} He + p -> ^{4} He + π^+ on the ^{3} He and proton polarization vectors is investigated. It is shown that the reaction p(^{3} He;, ^{4} He)π^+ on the polarized hydrogen target can be used for measuring the ^{3}He polarization. (author.). 8 refs.

22966 (JINR-E–3-93-428) **Study of the ^{40} Ca(n, α)^{37} Ar reaction induced by fast neutrons.** Gledenov, Yu.M. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics); Khuukhenkhuu, G.; Popov, Yu.P.; Bao Shanglian; Tang Guoyou; Qu Decheng; Cao Wentian; Chen Xemin; Chen Yingtang; Qi Huiquan. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 7p. Order Number DE94626848. Source: OSTI; NTIS (US Sales Only); INIS.

The angular distributions of α - particles emitted in the ^{40} Ca(n, α_0)^{37} Ar reaction have been measured at neutron energies of 4 and 5 MeV with a double-grid, parallel-plate, twin ionization chamber. Nearly monoenergetic neutrons were produced via the D(d, n)^3 He reaction using the Van de Graaff accelerator. For 5 MeV neutrons the (n, α_0) cross section has been found to be 234 ±23 Mb. These results were compared with other experimental data and the predictions of the statistical model. (author.) 19 refs.; 4 figs.

22967 (JINR-R–3-93-440) **^{237}Np fission cross section for the neutron energy up to $E_n \leq$ 500 eV.** Goverdovskij, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Dermendzhiev, E.; Ruskov, I.; Zamyatnin, Yu.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 6p. (In Russian). Order Number DE94626891. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yadernaya Fizika.

Measurements of the fission cross section of ^{237}Np up to the neutron energy of 500 eV were performed by using a time-of-flight method. The JINR IBR-30 booster was used as a pulse neutron source. The σ_f values for the resonance clusters obtained in this work are consistent with the Kyoto University (J P) data and are 3 times larger than the Saclay (F R) data. On the other hand our σ_f values for inter cluster regions are the same as those measured in Saclay. (author.). 8 refs.; 1 fig.; 1 tab.

22968 (JINR-R–7-93-442) **Excitation of nuclei by nonrelativistic heavy ions.** Fedotov, S.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1993. 10p. (In Russian). Order Number DE94626849. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Teoreticheskaya i Matematicheskaya Fizika.

Scattering of nonrelativistic heavy ions has been considered. Differential cross sections of scattering are derived by using Feynman path integrals. The continual integral is exactly taken over internal variables whereas over the trajectory of relative motion it is calculated in the quasiclassical approach. (author.). 11 refs.

22969 (KEK-PROC–93-15, pp. 77-82) **Photon cross section data PHOTOX for PEGS4 code.** Sakamoto, Yukio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1993. (In Japanese). (CONF-9307170–: 3. EGS4 users' meeting in Japan, Tsukuba (Japan), 26-28 Jul 1993). In *Proceedings of the third EGS4 users' meeting in Japan.* 134p. Order Number DE94753220. Source: OSTI; NTIS; INIS.

Photon cross section data of PHOTX library is adopted in the point kernel shielding calculation data of ANSI and in ENDF/B-VI. In order to check the results of point kernel calculations and Sn transport calculations by EGS4 code, the same cross section data library is needed. PHOTX data for PEGS4 code contain the partial cross section for photoelectric absorption, coherent scattering and pair production. As compared with DLC-15 data used in former PEGS4 code, photoelectric absorption cross section is different in lower photon energy. In the calculations of exposure buildup factors, the attenuation coefficients are different between two photon library but difference of the exposure buildup factors for same mean free path is small. (author).

22970 (LA-UR–94-1272) **Evaluation of the d + t cross sections based on an R-matrix analysis of the ^{5}He system.** Hale, G.M. Los Alamos National Lab., NM (United States). [1994]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404157–1-Vugraphs: IAEA Specialists'meeting on charged particle and photonuclear data evaluation's for FENDL, Smolenice (Slovakia), 18-21 Apr 1994). Order Number DE94011714. Source: OSTI; NTIS; GPO Dep.

This report contains graphics of the deuterium-tritium reaction cross sections based on a r-matrix analysis of the helium-5 system.

22971 (LA-UR–94-1541) **Data testing of ENDF/B-VI.** MacFarlane, R.E. Los Alamos National Lab., NM (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–21: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94013247. Source: OSTI; NTIS; INIS; GPO Dep.

A number of the fast reactor and thermal reactor benchmarks have been analyzed using nuclear data from ENDF/B-VI Release 2. Data were prepared with the NJOY nuclear data processing system in MATXS and ACE formats. Transport calculations were preformed with ONEDANT and TWODANT using transport tables prepared by the TRANSX code and with the MCNP Monte Carlo code.

22972 (LA-UR–94-1566) **Non-equilibrium evolution of the disoriented chiral condensate in heavy-ion collisions.** Kluger, Y. Los Alamos National Lab., NM (United States). [1994]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940280–1: Theoretical Physics Institute on continuous advances in quantum chromodynamics conference, Minneapolis, MN (United States), 17-20 Feb 1994). Order Number DE94012897. Source: OSTI; NTIS; INIS; GPO Dep.

We study the dynamics of the chiral phase transition expected during the expansion of the quark-qluon plasma produced in a high energy hadron or heavy ion collision in the O(4) linear sigma model to leading order in a large N expansion for strong coupling constants. Starting from an approximate equilibrium configuration at an initial proper time τ in the disordered phase, we study the transition to the ordered broken symmetry phase as the system expands and cools. We give results for the proper time evolution of the effective pion mass, the order parameter $< \sigma >$ as well as for the pion two point correlation function expressed in terms of a time dependent phase space number density and pair correlation density. We investigate the possibility of disoriented chiral condensate being formed during the expansion. In order to create large domains of disoriented chiral condensates low-momentum instabilities have to last for long enough periods of time. Our simulations show that instabilities that are formed during the initial stages of the expansion survive for proper times that are at most 3 fm/c.

22973 (LA-UR–94-1582) **Study of ^{27}Al(n,xγ) reactions up to a neutron energy of 400 MeV.** Hitzenberger, H. (Wien Univ. (Austria). Inst., fuer Radiumforschung und Kernphysik); Pavlik, A.; Vonach, H.; Chadwick, M.B.; Haight, R.C.; Nelson, R.O.; Young, P.G. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–13: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012893. Source: OSTI; NTIS; INIS; GPO Dep.

The prompt γ-radiation from the interaction of fast neutrons with Al was measured using the white neutron beam of the WNR facility at the Los Alamos National Laboratory. Partial production cross sections for residual nuclei in the range from F to Al were measured from threshold up to 400 MeV by observing the most intense γ-transitions between low lying levels of these nuclei. Two-dimensional neutron time-of-flight versus gamma pulse height spectra from the interaction of the neutrons with Al were observed after flight-paths of about 20 and 40 m with a high-purity Ge-detector. The neutron cross sections for prominent γ-transitions in a large number of residual nuclei could be derived with typical uncertainties of 10–20% up to a neutron energy of 400 MeV. The energy resolution varies from $\approx$0.2 MeV at 10 MeV to $\approx$50 MeV at 400 MeV. In the low energy range (up to 60 MeV) the results are compared with nuclear model calculations using the code GNASH. A very good overall agreement is obtained without special adjustment of parameters.

22974 (LA-UR–94-1621) **The ^{56}Fe(n,x α) reaction from threshold to 30 MeV.** Sterbenz, S.M. (and others); Young, P.G.; Bateman, F.B. Los Alamos National Lab., NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–16: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012890. Source: OSTI; NTIS; INIS; GPO Dep.

Alpha-particle emission in neutron reactions with ^{56}Fe has been studied from threshold to over 30 MeV using the spallation neutron source at WNR/LAMPF. Alpha-particle production cross sections, spectra, and angular distributions were measured at scattering angles of 30, 60, 90, and 135 degrees using detector telescopes consisting of a low-pressure gas proportional counter and a large area silicon detector. Time-of-flight techniques with a 10-meter flight path were used to deduce the incident neutron energies. Our results are compared with literature values and with several theoretical calculations.

22975 (LA-UR–94-1630) **The ^{59}Co(n,α) reaction from threshold to 30 MeV.** Lee, T.M. (and others); Sterbenz, S.M.; Bateman, F.B. Los Alamos National Lab., NM (United States).

[1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–14: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012889. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron-induced reactions that result in alpha-particle emission have been investigated for the target nucleus ^{59}Co over the neutron energy range from threshold to 30 MeV with the spallation neutron source at WNR/LAMPF. Double-differential cross sections were measured at alpha-particle emission angles of 30, 60, 90 and 135°. Integrated cross sections agree well with activation data below 14 MeV where only the ^{59}Co(n,α)^{56}Mn reaction contributes to alpha-particle emission. At higher energies, the integrated alpha-particle emission cross section exceeds the activation data. The results will be interpreted in terms of statistical and pre-compound reaction mechanisms. The sensitivity to nuclear level density parameters will be discussed.

22976 (LA-UR–94-1633) **Cross sections and spectra for charged-particle induced reactions.** Hale, G.M.; Talley, T.L. Los Alamos National Lab., NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–11: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012908. Source: OSTI; NTIS; INIS; GPO Dep.

Using calculational methods based on R-matrix theory, we have obtained cross sections and spectra for a number of charged-particle reactions, including those initiated by d+t, t+t, and t+^{6}Li. The three-body resonance model used to calculate the spectra resembles the sequential-decay model, but it sometimes gives different results. Contributions from resonances involving the detected particle can produce the broad structure underlying the narrow peaks in the spectra that is often attributed to "three-body phase space." We will show examples of calculated cross sections and spectra, compared to the measured data.

22977 (LA-UR–94-1661) **Cross sections for n+^{14}N from an R-matrix analysis of the ^{15}N system.** Hale, G.M. (Los Alamos National Lab., NM (United States)); Young, P.G.; Chadwick, M.B. Los Alamos National Lab., NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States);Defense Nuclear Agency, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–19: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94013125. Source: OSTI; NTIS; INIS; GPO Dep.

As part of the Hiroshima-Nagasaki Dose Reevaluation Program, a new evaluation of the neutron cross sections for ^{14}N was made for ENDF/B-VI, based at energies below 2.5 MeV on a multichannel R-matrix analysis of reactions in the ^{15}N system. The types of data used in the analysis, and the resulting cross sections and resonance structure for ^{15}N are briefly described. The resonant features of the neutron cross sections were especially well determined by including precise, high-resolution neutron total cross section measurements from ORNL. While the new evaluated cross section appear to be significant improvements over the earlier ones, they still need to be tested more extensively against recent measurements of the differential elastic cross section from Oak Ridge.

22978 (LA-UR–94-1663) **Validation of a large activation cross-section library.** Muir, D.W.; Wilson, W.B. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–18: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94013124. Source: OSTI; NTIS; INIS; GPO Dep.

The 63-group neutron cross-section library used for neutron activation studies in the Nuclear Theory and Applications Group at Los Alamos has a variety of sources of widely varying levels of quality. This heterogeneous aspect, which is a common feature of all libraries used in activation studies, is a direct consequence of the need to quickly obtain data for up to 15,000 different excitation functions involving 750 different targets. Because of the need to assess the reliability of this library and ten to improve it, we have initiated a systematic comparison of this library with three main data sources, especially the large CSISRS online data system, maintained by the National Nuclear Data Center at Brookhaven National Laboratory. We report on the results of extensive comparisons between the experimental data and the multigroup library. We briefly mention new theoretical approaches data evaluation that are suitable for meeting future data needs in this area.

22979 (LA-UR–94-1767) **Neutron-induced gamma-ray production from carbon and nitrogen.** Nelson, R.O.; Wender, S.A. Los Alamos National Lab., NM (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–12: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94012903. Source: OSTI; NTIS; INIS; GPO Dep.

Gamma-ray production cross sections and angular distributions were measured with five 7.6 cm diameter x 7.6 cm long BGO detectors at the high-energy white neutron source of the WNR facility at Los Alamos for targets of C $^{14}NH_3$ and $^{15}NH_3$. Gamma rays were measured in the energy range from 1.4 to 25 MeV. The incident neutron energies spanned the range from 2 to over 100 MeV. The detectors were positioned at angles of 39°, 55°, 90°, 125°, and 144° with respect to the neutron beam. We have extracted angular distributions and cross sections for the 4.44 and 15.1 MeV γ rays from inelastic excitation of C for $4 < E_n < 150$ MeV. In ENDF-B/VI these γ-rays are treated as being isotropic. Our angular distributions show that this is not the case. For the nitrogen isotopes we have extracted angular distributions and cross sections for several γ rays in the neutron energy range, $2 < E_n < 20$ MeV.

22980 (LA-UR–94-1830) **Calculation of proton and neutron emission spectra from proton reactions with ^{90}Zr and ^{208}Pb to 160 MeV with the GNASH code.** Young, P.G. (Los Alamos National Lab., NM (United States)); Chadwick, M.B. Los Alamos National Lab., NM (United States); Lawrence Livermore National Lab., CA (United States). [1994]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36 ; W-7405-ENG-48. (CONF-9405137–3: NEA/OECD specialists meeting on intermediate energy nuclear data codes, Paris (France), 30 May - 1 jun 1994). Order Number DE94013139. Source: OSTI; NTIS; INIS; GPO Dep.

A number of modifications have been made to the reaction theory code GNASH in order the accuracy of calculations at incident particle energies up to 200 MeV. Direct reaction a level density models appropriate for higher energy calculations are now used in the code, and most importantly, improved preequilibrium models have been incorporated into the code system. The code has been used to calculate proton-induced reactions on ^{90}Zr and ^{208}Pb for the International Code and Model Intercomparison for Intermediate Energy Reactions organized by the NEA. Calculations were performed with GNASH at incident proton energies of 25, 45, 80, and 160 mev using both the exciton model and Feshbach-Kerman-Koonin theory for the preequilibrium component. The models and procedures used in the GNASH calculations with the exciton model are described here. The results are compared to experimental data and to results from the GNASH calculations with Feshbach-Kerman-Koonin preequilibrium theory.

22981 (LBL–35234) **Multifragmentation: New dynamics or old statistics?.** Moretto, L.G.; Delis, D.N.; Wozniak, G.J. Lawrence Berkeley Lab., CA (United States). Oct 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9310319–1: International school on paradigms in nuclear physics, Erice (Italy), 10-15 Oct 1993). Order Number DE94011353. Source: OSTI; NTIS; INIS; GPO Dep.

The understanding of the fission process as it has developed over the last fifty years has been applied to multifragmentation. Two salient aspects have been discovered: 1) a strong decoupling of the entrance and exit channels with the formation of well-characterized sources: 2) a statistical competition between two-, three-, four-, five-, ... n-body decays.

22982 (UCRL-JC–116949) **Evaluation of LLNL-ALICE code contribution.** Blann, M. Lawrence Livermore National Lab., CA

(United States). 24 Mar 1994. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405137–2: NEA/OECD specialists meeting on intermediate energy nuclear data codes, Paris (France), 30 May - 1 jun 1994). Order Number DE94010895. Source: OSTI; NTIS; INIS; GPO Dep.

We summarize some of the areas of comparison with experimental data for which the ALICE code did poorly. We suggest some aspects which might be improved in the future. A crude accuracy factor is estimated as a predictive reliability based on the intercomparison exercise.

22983 (UCRL-JC–116950) **Intercomparison of codes for intermediate energy nuclear data: The first step.** Blann, M. (Lawrence Livermore National Lab., CA (United States)); Gruppelaar, H.; Nagel, P.; Rodens, J. Lawrence Livermore National Lab., CA (United States). 24 Mar 1994. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9405137–1: NEA/OECD specialists meeting on intermediate energy nuclear data codes, Paris (France), 30 May - 1 jun 1994). Order Number DE94010893. Source: OSTI; NTIS; INIS; GPO Dep.

Several weak points of the intermediate energy nuclear data calculated in this exercise are described as introduction to some of the areas needing discussion at this meeting. These include nuclear structure effects on precompound spectra, large variations between codes in predicted total reaction cross sections, and in total neutron and proton multiplicities. INC codes don't reflect correct experimental Q values, and may have difficulties at very low angles due to overestimation of the quasi-elastic peak. We raise questions as to additional reaction properties (beyond n and p spectra) which may need benchmarking.

22984 (WSRC-TR–94-0125) **AMPX-77 Phase 1 certification package.** Niemer, K.A. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94012948. Source: OSTI; NTIS; INIS; GPO Dep.

The AMPX-77 Phase 1 modules have been certified. AMPX-77 is a modular code system for generating coupled multigroup neutron-gamma cross section libraries from Evaluated Nuclear Data Files (ENDF/B). All basic cross-section data are input from the formats used by the ENDF/B, and output can be obtained from a variety of formats, included in its own internal and very general formats, along with a variety of other useful formats used by major transport, diffusion theory, and Monte Carlo codes. Processing is provided for both neutron and gamma-ray data. The AMPX-77 code system will be used at SRS to perform critical calculations related to nuclear criticality safety. The AMPX-77 modular codes system contains forty-seven separate modules. For the certification process, the 47 modules have been divided into three groups or phases. This Certification Package is for the Phase 1 modules: BONAMI, LAPHNGAS, MALOCS, NITAWL, ROLAIDS, SMUG, and XSDRNPM.

6635 Nuclear Mass Ranges

Refer also to citation(s) 21555, 22183, 22726, 22818, 22904, 22913, 22914, 22918, 22919, 22920, 22921, 22923, 22925, 22926, 22928, 22929, 22930, 22931, 22932, 22933, 22936, 22941, 22957, 22958, 22960, 22961, 22962, 22963, 22965, 22969, 22972, 22973, 22974, 22975, 22976, 22978, 22979, 22981, 22982

6636 Radiation Physics

Refer also to citation(s) 21127, 22442, 23288, 23290, 23301, 23332

22985 (ANL/TD/CP–82610) **Illicit substance detection using Fast-Neutron Transmission Spectroscopy.** Micklich, B.J.; Harper, M.K.; Novick, A.H.; Smith, D.L. Argonne National Lab., IL (United States). [1994]. 4p. Sponsored by Federal Aviation Administration, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DTFA03-03-X-00021. (CONF-940524–4: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94011523. Source: OSTI; NTIS; INIS; GPO Dep.

Fast-neutron interrogation techniques are of interest for detecting illicit substances such as explosives and drugs because of their ability to identify light elements such as carbon, nitrogen, and oxygen. Fast-Neutron Transmission Spectroscopy (FNTS) uses standard time-of-flight techniques to measure the energy spectrum of neutrons emitted from a collimated continuum source before and after transmission through the interrogated sample. The Monte Carlo transport code MCNP is used to model fast-neutron transmission experiments using a $^{9}Be(d,n)$ source [E_d= 5 MeV]. The areal densities (number of atoms per cm^2), and the uncertainties, of various elements present in the sample are determined by an unfolding algorithm which includes the effects of cross-section errors and correlations. Results are displayed in the form of normalized densities, including their errors and correlations, which are then compared to the values for explosives and benign substances. Probabilistic interpretations of the results are discussed in terms of substance detection and identification.

22986 (BNL–60186) **Positron implantation in solids.** Ghosh, V.J.; Lynn, K.G.; Welch, D.O. Brookhaven National Lab., Upton, NY (United States). [1993]. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9307155–3: International School of Physics on Enrico Fermi on positron spectroscopy of solids, Varenna (Italy), 6-30 Jul 1993). Order Number DE94013029. Source: OSTI; NTIS; GPO Dep.

The Monte Carlo technique for modeling positron prior to annihilation and electron implantation in semi-infinite metals is described. Particle implantation is modelled as a multistep process, a series of collisions with the atoms of the host material. In elastic collisions with neutral atoms there is no transfer of energy. The particle loses energy by several different channels, excitation of the electron gas, ionization of the ion cores, or, at low energies, by phonon excitation. These competing scattering mechanisms have been incorporated into the Monte Carlo framework and several different models are being used. Brief descriptions of these Monte Carlo schemes, as well as an analytic model for positron implantation are included. Results of the Monte Carlo simulations are presented and compared with expermental data. Problems associated with modeling positron implantation are discuss and the need for more expermental data on energy-loss in different materials is stressed. Positron implantation in multilayers of different metals is briefly described and extensions of this work to include a study of multilayers and heterostructures is suggested.

22987 (CONF-940407–20) **Neutron transport methods on scalable shared memory multiprocessors.** Azmy, Y.Y. Oak Ridge National Lab., TN (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Topical meeting on advances in reactor physics; Knoxville, TN (United States); 11-14 Apr 1994. Order Number DE94012324. Source: OSTI; NTIS; GPO Dep.

We describe the parallel implementation of the Source Iterations traditionally used in solving the neutron transport equation on the highly-scalable shared memory, two-ringed Kendall Square, KSR1, with 64 cells. The program used in this work is the two-dimensional, Cartesian geometry, Arbitrarily High Order Transport (AHOT) code which has a nodal and a characteristic method option. The parallel algorithm employs an angular domain decomposition in the mesh sweep stage, and a spatial domain decomposition in the convergence test and iterate update stages, resulting in high speedup factors at parallel efficiencies in the 90% range. We construct a preliminary performance model for the parallel algorithm, and validate it against measured execution times.

22988 (CONF-940424–35) **SINBAD: A shielding integral benchmark archive and database for PC's.** Hunter, H.T.; Ingersoll, D.T.; Roussin, R.W.; Sartori, E.; Slater, C.O. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 8. international conference on radiation shielding; Arlington, TX (United States); 24-27 Apr 1994. Order Number DE94012730. Source: OSTI; NTIS; INIS; GPO Dep.

Within the last 30 years, many shielding "benchmark" experiments, involving thermal and fast reactor spectra, as well as fusion reactor sources, have been performed worldwide. The results provide a means to perform quality assurance and consistency checks

on recently developed transport codes and cross-section libraries. An effective means for storing, locating, and retrieving these experimental and calculational benchmark results for nuclear systems is under development. A new electronic data base called SINBAD, has the flexibility and a detailed storage structure capable of handling the many types of data found in benchmarks. These data are related by classifications and subclassifications so they may be quickly and efficiently reassembled at the user's control. Output for data searching may be first perused at the screen and then printed and/or saved to a computer file for future use in user's calculations. Future graphic display developments will allow a more comprehensive examination of the experimental geometry detail and data comparison.

22989 (DOE/ER/12899–T1) **A fundamental study of contribution transport theory and channel theory applications: Final project report.** Williams, M.L. (Louisiana State Univ., Baton Rouge, LA (United States). Nuclear Science Center). Louisiana State Univ., Baton Rouge, LA (United States). Jul 1994. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER12899. Order Number DE94013463. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this project was to develop a new theoretical method called "contribution theory" that can be used to gain deeper understanding of radiation transport phenomena. The method had been propose during the 1970's as a promising technique for improving radiation shield designs, and was actually applied to several reactor shielding studies at that time. However the theoretical basis of the method was never firmly established, and numerical procedures were not developed for efficient use of the method. Hence one important component of this project is to perform a study of the basic theory of contributions to understand how to better apply the method, and to develop calculational methods for using the theoretical tools effectively. Furthermore, the fundamental concepts of contribution theory can be applied in other areas besides shielding optimization, including Monte Carlo calculations and neutron spectrum analysis; therefore the project also examined possible extended uses of contribution theory. Finally, in order for the method to become a useful tool for radiation transport analysis, it is necessary to demonstrate that it can be used to analyze realistic configurations; therefore the project also has developed computer programs that can be applied to realistic systems.

22990 (DOE/ER/14355–T1) **Linear kinetic theory and particle transport in stochastic mixtures: Progress report, June 15, 1993–March 21, 1994.** Pomraning, G.C. California Univ., Los Angeles, CA (United States). School of Engineering and Applied Science. Mar 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-93ER14355. Order Number DE94013167. Source: OSTI; NTIS; INIS; GPO Dep.

The primary goal in this research is to develop a comprehensive theory of linear transport/kinetic theory in a stochastic mixture of solids and immiscible fluids. The statistics considered correspond to N-state discrete random variables for the interaction coefficients and sources, with N denoting the number of components of the mixture. The mixing statistics studied are Markovian as well as more general statistics, such as renewal processes. A further goal of this work is to demonstrate the applicability of the formalism to real world engineering problems. This three year program was initiated June 15, 1993 and has been underway nine months. Many significant results have been obtained, both in the formalism development and in representative applications. These results are summarized by listing the archival publications resulting from this grant, including the abstracts taken directly from the papers.

22991 (EGG–11265-3007) **Data simulation for the Associated Particle Imaging system.** Tunnell, L.N. EG and G Energy Measurements, Inc., Santa Barbara, CA (United States). Special Technologies Lab. [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265. (CONF-940216–2: Nondestructive assay and nondestructive examination waste chracterization conference, Pocatello, ID (United States), 14-16 Feb 1994). Order Number DE94012664. Source: OSTI; NTIS; INIS; GPO Dep.

A data simulation procedure for the Associated Particle Imaging (API) system has been developed by postprocessing output from the Monte Carlo Neutron Photon (MCNP) code. This paper compares the simulated results to our experimental data.

22992 (EGG–11265-5122) **Relativistic collision rate calculations for electron-air interactions.** Graham, G. (EG and G Energy Measurements, Inc., Los Alamos, NM (United States)); Roussel-Dupre, R. EG and G Energy Measurements, Inc., Los Alamos, NM (United States); Los Alamos National Lab., NM (United States). 16 Dec 1992. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-93NV11265 ; W-7405-ENG-36. Order Number DE94013566. Source: OSTI; NTIS; INIS; GPO Dep.

The most recent data available on differential cross sections for electron-air interactions are used to calculate the avalanche, momentum transfer, and energy loss rates that enter into the fluid equations. Data for the important elastic, inelastic, and ionizing processes are generally available out to electron energies of 1–10 kev. Prescriptions for extending these cross sections to the relativistic regime are presented. The angular dependence of the cross sections is included where data is available as is the doubly differential cross section for ionizing collisions. The collision rates are computed by taking moments of the Boltzmann collision integrals with the assumption that the electron momentum distribution function is given by the Juettner distribution function which satisfies the relativistic H- theorem and which reduces to the familiar Maxwellian velocity distribution in the nonrelativistic regime. The distribution function is parameterized in terms of the electron density, mean momentum, and thermal energy and the rates are therefore computed on a two-dimensional grid as a function of mean kinetic energy and thermal energy.

22993 (ENEA-RT-ERG–93-18) **Splitting and Russian Roulette: Parts A and B.** Burn, K.W. (ENEA, Bologna (Italy). Centro Ricerche Energia 'E. Clementel' - Area Energetica). ENEA, Bologna (Italy). Centro Ricerche Energia 'E. Clementel' - Area Energetica. Nov 1993. 56p. (RT/ERG–93-18). Order Number DE94775317. Source: OSTI; NTIS (US Sales Only).

The approach of surface splitting and Russian Roulette (RR) to variance reduction in fixed source Monte Carlo neutron and photon transport calculations is treated in a didactic fashion starting from first principles. The Direct Statistical Approach to optimizing the splitting R/R parameter is introduced and summarized.

22994 (INDC(CCP)–369) **Secondary neutron emission spectra from spherical and hemispherical samples of materials obtained at 14 MeV neutron energy.** Saukov, A.I. (All-Union Scientific Research Inst. of Engineering Physics, Chelyabinsk (Russian Federation)); Sukhanov, B.I.; Ryabinin, A.M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1994. 27p. Translated by Lorenz, A. from a Russian original published in Yadernye Konstanty 4/1991. Order Number DE94626908. Source: OSTI; NTIS (US Sales Only); INIS.

Results of secondary neutron spectra measurements carried out in the 0.4-14 MeV energy range on spherical and hemispherical samples of Mg, Al, Fe, Ni, Cu, Zr, Ti, Mo, C, CF, Pb, ^{238}U, Be, H_2O, D_20 and CH_2 using the time-of-flight method at 14 MeV neutron energy are presented. The experimental results are given in the form of normalized measured emission spectra for 13 neutron energy ranges. The results obtained can be used to improve the quality of existing nuclear data libraries. (author). 12 refs, 34 figs, 2 tabs.

22995 (JAERI-M–93-228, pp. 717-722) **Superthermal UCN-production at JAERI: Analysis.** Shimizu, H.M. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Kawai, T.; Sakai, K. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The experimental results concerning the production of ultra-cold-neutrons (UCN_s) in superfluid helium at 0.45 - 1.5K contained in a stainless-steel tube of 3m long and 8cm diameter was analyzed by a numerical simulation which took into account the non-isotropic

momentum distribution. The experimental method to study the momentum distribution and to determine the UCN density in the long tube is discussed. (author).

22996 (JAERI-M–93-228, pp. 780-787) **Quantitative neutron radiography using neutron absorbing honeycomb: Basic research and application.** Tamaki, Masayoshi (Nagoya Univ. (Japan). Faculty of Engineering); Oda, Masahiro; Takahashi, Kenji; Ohkubo, Kohei; Tasaka, Kanji; Tsuruno, Akira; Matsubayashi, Masahito. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

This investigation concerns quantitative neutron radiography and computed tomography by using a neutron absorbing honeycomb collimator. By setting the neutron absorbing honeycomb collimator between object and imaging system, neutrons scattered in the object were absorbed by the honeycomb material and eliminated before coming to the imaging system, but the neutrons which were transmitted the object without interaction could reach the imaging system. The image by purely transmitted neutrons gives the quantitative information. Two honeycombs were prepared with coating of boron nitride and gadolinium oxide and evaluated for the quantitative application. The relation between the neutron total cross section and the attenuation coefficient confirmed that they were in a fairly good agreement. Application to quantitative computed tomography was also successfully conducted. The new neutron radiography method using the neutron-absorbing honeycomb collimator for the elimination of the scattered neutrons improved remarkably the quantitativeness of the neutron radiography and computed tomography. (author).

22997 (JAERI-M–93-246) **A differential albedo for a Monte Calro criticality program KENO IV.** Komuro, Yuichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kawasaki, Hiromitsu; Kaneko, Toshiyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 24p. (In Japanese). Order Number DE94770601. Source: OSTI; NTIS; INIS.

To carry out numbers of survey-type criticality calculations, differential albedos of some reflector materials obtained from ANISN calculation with Hansen-Roach 16 group cross section data are incorporated in Monte Carlo criticality program KENO IV. Although the albedo option is a powerful tool that can save computer time, the above albedo data are not applicable to KENO IV calculation with the multigroup constants libraries MGCL's (26 group and 137 group) in criticality analysis code system JACS due to the difference of energy structure between MGCL libraries and the 16 group albedo data. A new differential albedo of 30 cm-thick water reflector has been generated by ANISN (P_3, S_8, fixed source problem) using 26 group MGCL-J3 for the users of the JACS system. Values of k_{eff} calculated by the rigorous method and those by the 26 group differential albedo were in good agreement for sphere and infinitely long systems with thick water reflector. For an infinitely long slab system, computer time of KENO IV calculation with the 26 group albedo was 60% shorter than that with the rigorous reflector treatment. (author).

22998 (JINR-E–3-93-418) **Neutron quantum reflection.** Frank, A.I.; Amandzholova, D.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Neutron Physics. 1993. 10p. Order Number DE94626909. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yadernaya Fizika.

The problem of neutron reflection from a medium with an oscillating potential is considered. The reflected wave state represents a superposition of coherent waves of various normal wave number components and energies. When thermal and cold neutrons are reflected, these waves are separated in space. Possible experimental observation of this phenomenon and also possible applications in reflectometry are discussed. (author.). 12 refs.; 3 figs.

22999 (KEK-PROC–93-15, pp. 68-71) **A new approximation expression for gamma ray buildup factors of multilayered shields.** Shin, Kazuo (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering); Hirayama, Hideo. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1993. (In Japanese). (CONF-9307170–: 3. EGS4 users' meeting in Japan, Tsukuba (Japan), 26-28 Jul 1993). In *Proceedings of the third EGS4 users' meeting in Japan.* 134p. Order Number DE94753220. Source: OSTI; NTIS; INIS.

A new approximation expression for gamma-ray buildup factors of multilayered shields is proposed. The expression is formulated based on the vector form and treats the gamma-ray energy spectrum directly. It treats the gamma-ray attenuation by a transmission matrix and the backscattering by an albedo matrix. Its capability of reproducing the buildup factors for multilayered shields is demonstrated by using those of double layered shields composed of water and lead at 1,3,6 and 10 MeV. The data of three layered shields of water, iron and lead are also very well reproduced at 1 and 10 MeV. (author).

23000 (LA-UR–94-1292) **Basic physics with spallation-neutron sources.** Michaudon, A.F. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940507–8: International conference on nuclear data for science and technology, Gatlinburg, TN (United States), 9-13 May 1994). Order Number DE94011715. Source: OSTI; NTIS; INIS; GPO Dep.

The neutron has unique intrinsic properties widely used in basic and applied sciences. The neutron plays a well-known role in applied sciences and technology and is a unique probe well suited for the exploration of condensed-matter properties. But the neutron is also used for many other basic-physics studies, including nuclear physics, particle physics, fundamental physics, astrophysics, and cosmology. These last studies are briefly reviewed in this paper. Spallation-neutron sources today have unmatched neutron-beam properties for such studies and have great potential in future technological developments whereby these studies could be carried out under much improved conditions.

23001 (UCRL-JC–114673) **Analytical calculations of multiple scattering for high energy photons and neutrons.** Thoe, R.S. Lawrence Livermore National Lab., CA (United States). Apr 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940439–1: Algorithms for synthetic aperture radar imagery, Orlando, FL (United States), 5-8 Apr 1994). Order Number DE94012671. Source: OSTI; NTIS; INIS; GPO Dep.

Radiography of large dense objects often require the use of highly penetrating radiation. For example, a couple of centimeters of steel attenuates 50 keV x-rays by a factor of approximately 10^{-14} whereas this same amount of steel would attenuate a 500 keV photon beam by only a factor of about 0.25. However, this increase in penetrating power comes with a price. In the case of x-radiation there are two bills to pay: (1) For projection radiography, this increase in penetration directly causes a corresponding decrease in resolution. (2) This increase in penetration occurs in a region where the interaction of radiation and matter is changing from absorption to scattering. In the above example the fraction of scattering goes from about 0.1 at 50 keV to over 0.99 at 500 keV. These scattered photons can significantly degrade contrast. In order to overcome some of these difficulties, radiography using scattered photons has been studied by myself and numerous other authors. In all the above cases, calculation of the intensity of scattered radiation is of primary importance. In cases where scattering is probable, multiple scattering can also be probable. Calculations of multiple scattering are generally very difficult and usually require the use of extremely sophisticated Monte Carlo simulations. It is not unusual for these calculations to require several hours of CPU time on some of the worlds largest and fastest supercomputers. In this paper I will present an alternative approach. I will present an analytical solution to the equations of double scattering, and show how this solution can extended to the case of higher order scattering. Finally, I will give numerical examples of these solutions and compare them to solutions obtained by Monte Carlo simulations.

6640 Atomic and Molecular Physics

Refer also to citation(s) 22753

6641 Theory of Electronic Structure of Atoms and Molecules

Refer also to citation(s) 22092, 23002

23002 (DOE/ER/13867–14) **MCHF calculations of isotope shifts; I program implementation and test runs II large-scale active space calculations.** Joensson, P. (Lund Institute of Technology, Lund (Sweden)); Fischer, C.F. Vanderbilt Univ., Nashville, TN (United States). 30 Mar 1994. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13867. Order Number DE94013036. Source: OSTI; NTIS; INIS; GPO Dep.

A new isotope shift program, part of the MCHF atomic structure package, has been written and tested. The program calculates the isotope shift of an atomic level from MCHF or CI wave functions. The program is specially designed to be used with very large CI expansions, for which angular data cannot be stored on disk. To explore the capacity of the program, large-scale isotope shift calculations have been performed for a number of low lying levels in B I and B II. From the isotope shifts of these levels the transition isotope shift have been calculated for the resonance transitions in B I and B II. The calculated transition isotope shifts in B I are in very good agreement with experimental shifts, and compare favourably with shifts obtained from a many-body perturbation calculation.

6642 Spectra of Atoms and Molecules and Their Interactions With Photons

23003 (LA-UR–94-1226) **NIR without overtone/combination bands?.** Burns, D.A. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9404158–1: 6. Near-IR (NIR) international conference, Victoria (Australia), 18-22 Apr 1994). Order Number DE94011658. Source: OSTI; NTIS; GPO Dep.

This report investigates near-infrared radiation without overtone or combination bands.

6643 Collision Phenomena

Refer also to citation(s) 22079

23004 (CNIC–00706, pp. 70-73) **Reflection of H and D plasma particles from solid surfaces.** Yao Jinzhang (Chinese Nuclear Data Center, IAE (China)); Fang Shaohong; Yu Hongwei. Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The calculation results of reflection coefficients Rn and Re of projectiles H and D on B, Be, C, Ae, Si, Ti, Fe, Ni, Cu, Mo, W and Au targets by empirical formula have been presented. The incident range is from 10 eV to 100 KeV and the incident angle is from 0 to 90 degrees. Data on particle and energy reflection coefficients of plasma particles at first wall materials in thermonuclear fusion devices are required.

6644 Experimentally Derived Information On Atomic and Molecular Properties

Refer also to citation(s) 22784

23005 (ANL/CHM/PP–80876) **Vibrational studies of ^{13}C- and ^{34}S-labelled bis(ethylenedithio)tetrathiafulvalene (ET) donor molecule.** Ferraro, J.R. (Argonne National Lab., IL (United States)); Kini, A.M.; Williams, J.M.; Stout, P. Argonne National Lab., IL (United States). [1994]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012637. Source: OSTI; NTIS; GPO Dep.

FT-IR and FT-Raman studies of ^{13}C- and ^{34}S-labelled bis(ethylenedithio)-tetrathiafulvalene (BEDT-TTF or ET) electron-donor molecules were made and the results presented herein. Assignments for fundamental vibrations in ET were verified. Spectral data confirms that ET has no center-of-symmetry, and that the data can be reconciled by a D-type point group with only slight interactions occurring between the 4 molecules per unit cell.

23006 (CONF-940414–2) **Attachment of low energy electrons to "hot" SF_6 molecules.** Datskos, P.G. (Oak Ridge National Lab., TN (United States)); Cristophorou, L.G.; Carter, J.G. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Contract AF33615-92-C-2221. From 7. international symposium on gaseous dielectrics; Knoxville, TN (United States); 24-28 Apr 1994. Order Number DE94012749. Source: OSTI; NTIS; INIS; GPO Dep.

The low energy electron attachment rate constant, k_a, for SF_6 has measured in dilute mixtures of SF_6 with N_2 buffer gas in the temperature, T, range of 300 to 500 K and over a range of E/N values corresponding to mean electron energies, $< \epsilon >$, ranging from 0.19 to 1.0 eV. As the gas temperature increases, the magnitude and energy dependence of k_a ($< \epsilon >$, T) remain unaffected. In the same T-range the collisionally stabilized SF_6^- is very stable with respect to autodetachment; its lifetime is > 1ms. The limiting electric field strength $(E/N)_{lim}$ for SF_6 was found to increase by ~14% as T is raised from 300 to 600 K. The significance of these finding in gaseous dielectrics is indicated.

6645 Special Atoms and Molecules

23007 (INS–958) **Production of deeply-bound pionic atoms.** Yamazaki, Toshimitsu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1992. 13p. Order Number DE94770775. Source: OSTI; NTIS; INIS.

Deeply-bound pionic atoms in heavy nuclei constitute a new family of Gamow-Teller resonance states which are located just below the pion emission threshold. Since they are not populated by pionic x-ray cascades, special nuclear reactions (pion-transfer reactions) have been proposed. Particularly interesting are (n,d) and (d,^{3}He) reactions on ^{208}Pb. Theoretical studies as well as experimental programs are described. (author).

23008 (JINR-E–1-93-450) **On measurement of cross sections for scattering of $p\mu$ - and d μ -atoms in hydrogen and deuterium.** Bystritskij, V.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1993. 11p. Order Number DE94626957. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Yadernaya Fizika.

The paper is a brief review of all experiments on measurement of cross sections for scattering of $p\mu$ - atoms in hydrogen and $d\mu$ - atoms in hydrogen and deuterium. The experimental results are analysed and compared both with one another and with calculated results. A program for further investigation of scattering of muonic atoms of hydrogen isotopes is proposed in order to clarify the nature of discrepancies between some experimental results and to get more precise information about the above processes. (author.). 24 refs.; 4 figs.; 3 tabs.

6650 Physics of Condensed Matter

Refer also to citation(s) 22429, 22434, 22753

23009 (DOE/ER/14303–3) **Interacting fronts in a model for binary-mixture convection.** Riecke, H. (Northwestern Univ., Evanston, IL (United States). Dept. of Engineering Sciences and Applied Mathematics); Herrero, H. Northwestern Univ., Evanston, IL (United States). Dept. of Engineering Sciences and Applied Mathematics. [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14303. (CONF-9404137–3: 12. symposium on energy engineering sciences, Argonne, IL (United States), 27-29 Apr 1994). Order Number DE94013595. Source: OSTI; NTIS; GPO Dep.

Motivated by the observation of localized traveling-wave states ('pulses') in convection in binary liquid mixtures, the interaction of

fronts is investigated in a real Ginzburg-Landau equation which is coupled to a large-scale field. In that system the Ginzburg-Landau equation describes the traveling-wave amplitude and the large-scale field corresponds to a concentration mode which arises due to the slowness of mass diffusion. For single fronts the large-scale field can lead to a hysteretic transition between slow and fast fronts. Its contribution to the interaction between fronts can be attractive as well as repulsive and depends strongly on their direction of propagation. Based on this mechanism alone, pairs of fronts in binary-mixture convection are expected to form stable pulses if they travel backward, i.e. opposite to the linear group velocity. For positive velocities the interaction becomes attractive and destabilizes the pulses. This is in qualitative agreement with recent experimental results. This new localization mechanism does not require any dispersion in contrast to that operating in the complex Ginzburg-Landau equation.

23010 (LA-UR–94-1853) **Theory of metal insulator transition in strongly correlated electron systems.** Gulacsi, M.; Bedell, K.S. Los Alamos National Lab., NM (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9403120–2: 6. international symposium on integrated ferroelectrics, Monterey, CA (United States), 14-16 Mar 1994). Order Number DE94013135. Source: OSTI; NTIS; INIS; GPO Dep.

A comprehensive theory of the correlation driven metal insulator transition in 1D and 2D strongly correlated electron systems is given. In both the 1D and 2D Hubbard model the metal insulator transition encountered close to half filling is of Pokrovsky-Talapov type. An important consequence of this in the 2D Hubbard model is the break down of the Fermi liquid theory. We also describe in detail the properties of the Pokrovsky-Talapov transition in 2D ferroelectrics.

6651 Nuclear Techniques in Condensed Matter Physics

Refer also to citation(s) 21976, 21979, 22985

23011 (BNL–70387) **Participation in the United States: Japan Collaborative Program on neutron scattering: Foreign trip report, November 4–24, 1993.** Cox, D.E. Brookhaven National Lab., Upton, NY (United States). 8 Dec 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE94004634. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes activities during a recent trip to Japan for the purpose of visiting several laboratories and major facilities, with special emphasis on neutron and synchrotron x-ray powder diffraction instrumentation and techniques. Current programs and future directions were discussed with a number of the leading scientists using these techniques.

23012 (DOE/ER/45233–9) **Application of spin-sensitive electron spectroscopies to investigations of electronic and magnetic properties of solid surfaces and epitaxial systems: Progress report, 1 November 1993–31 October 1994.** Walters, G.K.; Dunning, F.B. Rice Univ., Houston, TX (United States). May 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER45233. Order Number DE94012981. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

Research during the current grant year has focused on: (1) Measurements of the relative contributions of dipole- and impact-scattering to the energy loss spectrum of electrons backscattered from paramagnetic and ferromagnetic metal surfaces, using Spin-Polarized Electron Energy Loss Spectroscopy (SPEELS). (2) Studies of the mechanisms whereby He(2^3S), He(2^1S), and He(2^3P) atoms are deexcited at Ar and Xe films deposited on metallic surfaces, using Spin-Polarized Metastable (Atom) Deexcitation Spectroscopy (SPMDS). (3) Development of a high-efficiency Mott polarimeter for use in Scanning Electron Microscopy with Polarization Analysis (SEMPA). (4) Development of a low-energy spin-polarized He^+ ion beam for magnetic imaging of surfaces and thin epitaxial films.

23013 (INIS-BR–3332) **Study of the ferrimagnetic and paramagnetic phases of magnetite measured by multiple neutron diffraction.** Mazzocchi, V.L. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1992. 137p. (In Portuguese). Order Number DE94627031. Source: OSTI; NTIS (US Sales Only); INIS.

Structural parameters of the ferrimagnetic and paramagnetic phases of magnetite have been refined from neutron multiple diffraction data. Experimental multiple diffraction patterns used in the refinement, were obtained by measuring the 111 primary reflection of a natural single crystal of this compound, at room temperature for the ferrimagnetic phase and 703^0 C for the paramagnetic phase. Corresponding theoretical patterns for both phases have been calculated by the program MULTI which uses the iterative method for the intensity calculations in neutron multiple diffraction. In this method intensities are calculated as Taylor series expansions summed up to a order sufficient for a good approximation. A step by step process has been used in the refinements according to the parameter-shift method. Both isotropic and anisotropic thermal parameters were used in the calculation of the temperature factor. (author).

23014 (INIS-BR–3336) **Surface analysis in steel nitrides by using Moessbauer spectroscopy.** Figueiredo, R.S. de. Santa Catarina Univ., Florianopolis, SC (Brazil). Jul 1991. 168p. (In Portuguese). Order Number DE94627032. Source: OSTI; NTIS (US Sales Only); INIS.

The formation of iron nitride layer at low temperatures, 600-700 K, by Moessbauer spectroscopy is studied. These layers were obtained basically through two different processes: ion nitriding and ammonia gas nitriding. A preliminary study about post-discharge nitriding was made using discharge in hollow cathode as well as microwave excitation. The assembly of these chambers is also described. The analysis of the nitrided samples was done by CEMS and CXMS, aided by optical microscopy, and the CEMS and CXMS detectors were constructed by ourselves. We also made a brief study about these detectors, testing as acetone as the mixture 80% He+10% C H_4 as detection gases for the use of CEMS. The surface analysis of the samples showed that in the ammonia gas process nitriding the nitrided layer starts by the superficial formation of an iron nitride rich nitrogen. By thermal evolution this nitride promotes the diffusion of nitrogen and the formation of other more stable nitrides. (author).

23015 (INIS-mf–13808, pp. 91) **Positron annihilation in solid two-phase systems.** Bischof, G. (Vienna Univ. (Austria). Inst. fuer Festkoerperphysik); Pahl, W.; Groeger, V.; Krexner, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. METALS/binary alloy systems; POSITRONS/annihilation; METALS; POSITRONS; ANNIHILATION; PRECIPITATION

23016 (INIS-RU–376) **Programme and abstracts of the 5. International conference on nuclear spectroscopic investigations of hyperfine interactions.** Godovikov, S.K.; Parfenova, V.P. (eds.). Joint Inst. for Nuclear Research, Dubna (Russian Federation); AN SSSR, Moscow (Russian Federation). Fizicheskij Inst.; Moskovskij Gosudarstvennyj Univ., Moscow (Russian Federation); Moskovskij Gosudarstvennyj Univ., Moscow (Russian Federation). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1993. 185p. (In Russian, English). (CONF-9309159–: 5. international conference on nuclear spectroscopic studies of hyperfine interactions, Dubna (Russian Federation), 21-25 Sep 1993). Order Number DE94627033. Source: OSTI; NTIS (US Sales Only); INIS.

Papers on nuclear-spectroscopic investigations on hyperfine interactions are presented: theoretical and experimental investigations of hyperfine structure, recommendations on usiing results in nuclear physics, solid-state physics and etc.

23017 (JAERI-M–93-228, pp. 391-398) **Neutron scattering study of MnX_2 (X = Br, I).** Sato, Taku (Tokyo Inst. of Tech.

(Japan). Dept. of Physics); Kadowaki, Hiroaki. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Successive magnetic phase transitions in MnX_2 (X = Br, I), found by bulk measurements, are studied by neutron scattering experiments. There occur two (T_{N1} = 2.32K, T_{N2} = 2.17K) and three (T_{N1} = 3.95K, T_{N2} = 3.8K, T_{N3} = 3.45K) phase transitions in $MnBr_2$ and MnI_2, respectively. We have found that magnetic structures of the both compounds in the intermediate temperature phases ($MnBr_2$: $T_{N1} > T > T_{N2}$; MnI_2: $T_{N1} > T > T_{N3}$) are transverse sinusoidally-modulated structures with incommensurate wave-vectors which vary as a function of temperature. As the temperature is lowered into the lowest temperature phases, the magnetic structures change via first order transition into ↑↑↓↓ and a helical structure for $MnBr_2$ and MnI_2, respectively, which were determined by previous experiments. The successive phase transitions in $MnBr_2$ are accounted for quantitatively using a mean field approximation of a Hamiltonian consisting of exchange interactions up to third inter- and third intra-layer neighbor sites and the dipolar interaction. (author).

23018 (JAERI-M–93-228, pp. 399-403) **Pressure dependence of the antiferromagnetic ordering temperature of face-centered-cubic iron.** Onodera, Akifumi (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science); Tsunoda, Yorihiko; Kunitomi, Nobuhiko; Pringle, O.A.; Nicklow, R.M.; Moon, R.M. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The Neel temperature T_N of fcc Fe has been measured as a function of pressure to 8.7 kbar by neutron diffraction using a high pressure cell of supported-cylinder type. Cold-pressed zirconia was employed for the material of the cylinder. A sample with 2.77 at% of fcc Fe, precipitated in a Cu matrix, and having precipitates size between 500 and 600 A, undergoes antiferromagnetic ordering at 67±2 K at ambient pressure. With increasing pressure, T_N decreases following a relation; $T_N(K) = 67 - 1.28p - 1.11 \times 10^{-1}p^2 - 6.17 \times 10^{-3}p^3$, where p is in kbar. (author).

23019 (JAERI-M–93-228, pp. 404-409) **Magnetic order in the competing interaction state of ternary intermetallics $DyMn_2Si_2$ and $DyMn_2Ge_2$.** Ohashi, Masayoshi (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Onodera, Hideya; Ono, Takahito; Andow, Tetsuo; Yamaguchi, Yasuo; Funahashi, Satoru; Kobayashi, Hisao. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Precise powder neutron diffraction measurements were performed on the rare-earth intermetallic compounds $DyMn_2Si_2$ and $DyMn_2Ge_2$ with the body-centered tetragonal structure of the $ThCr_2Si_2$-type. Both materials have three magnetically ordered phases. The high temperature phase takes the antiferromagnetic order just by the Mn moments along the c-axis, where the Dy moments are disordered. The low temperature phase has the ferrimagnetic structure in which the ferromagnetic layers of the Dy and Mn moments are coupled antiferromagnetically, except canting of Mn moments in $DyMn_2Si_2$. The intermediate temperature phase appears between 33 K and 37.5 K for $DyMn_2Ge_2$ and between 22.4 K and 36.7 K for $DyMn_2Si_2$. The moments modulation magnetic structure along the c-axis is proposed from the magnetic reflections which are observed at not only the nuclear reflection angles but also the satellite positions of the nuclear scattering, (1, 0, 1±δ), (1, 0, 3-δ), and (1, 1, ±δ) where -0.66, -0.68. This state is attributed to the competing exchange interactions between Dy-Mn(AF) and Mn-Mn(AF) along the c-axis under strong anisotropy. (author).

23020 (JAERI-M–93-228, pp. 410-415) **Magnetic phase transition of $CsNiCl_3$.** Ubukata, Katsunori (Kobe Univ. (Japan). Dept. of Physics); Motokawa, Mitsuhiro; Inami, Toshiya; Kakurai, Kazuhisa. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

In this contribution we would like to report the preliminary results on sublattice magnetization of $CsNiCl_3$, a quasi one-dimensional (1-D), S = 1, antiferromagnetic (AF) Heisenberg system with weak easy axis anisotropy, near its spin flop field. A comparison with a more classical system $CsMnI_3$ with S = 5/2 indicates, that the fine structures observed in the sublattice magnetization of this S = 1 system may be related to the quantum nature of the system. (author).

23021 (JAERI-M–93-228, pp. 416-420) **Magnetic phase transition of $CsCuCl_3$ in pulsed magnetic field.** Mino, Michinobu (Kobe Univ. (Japan). Dept. of Physics); Ubukata, Katsunori; Bokui, Takahiro; Arai, Masatoshi; Motokawa, Mitsuhiro; Tanaka, Hidekazu. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Neutron diffraction measurements of a triangular lattice antiferromagnet $CsCuCl_3$ have been done in a pulsed high magnetic field up to 14T. The field applied parallel to the c-axis and it is observed that the reflection intensity at (1/3 1/3 0.085), which corresponds to the low field magnetic structure, abruptly decreases at Bc = 10T, where the magnetization shows a small jump. Above Bc, a new reflection at (1/3 1/3 0) appears. These results are consistent with a model that a new type of magnetic phase transition occurs due to the quantum effect. (author).

23022 (JAERI-M–93-228, pp. 421-425) **Dynamic magnetic response of a gap-type Kondo material CeNiSn.** Kohgi, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Ohoyama, K.; Osakabe, T.; Kasaya, M.; Takabatake, T.; Fujii, H. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The magnetic response of the gap-type Kondo system CeNiSn was studied by means of neutron inelastic scattering. No well defined crystal field excitations were observed. Instead, the spectrum is composed of a Lorentzian-like response centered at E = 0 and a broad peak around 4 - 7 meV which develops strongly below about 15 K. The results indicate that the 4f electron state in this system is more like valence-fluctuating and that the anomalous temperature dependence of the peak corresponds to the development of a short range magnetic correlation at the low temperatures. (author).

23023 (JAERI-M–93-228, pp. 426-433) **Magnetic phase diagram of oxygen nonstoichiometric $La_2NiO_{4+\delta}$.** Omata, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Yamada, K.; Nakajima, K.; Hosoya, S.; Endoh, Y. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Present neutron scattering and magnetization measurements reveal that $La_2NiO_{4+\delta}$ provides lots of varieties of physical properties, in particular in magnetism, as a function of the excess oxygen concentration. Observed experimental results resolved the complexity in the magnetic phase diagram of the previous works. At least three different antiferromagnetic phases separated by the biphasic

regions are discovered in the present concentration range. In particular the samples with δ larger than about 0.1 exhibit a new type of magnetic ordering with the in plane cycloid-type incommensurate modulation. (author).

23024 (JAERI-M–93-228, pp. 439-446) **Powder neutron diffraction study on $Pb_2Sr_2YCu_3O_{8+\delta}$($\delta$ = 0.0 and 1.67).** Fujishita, Hideshi (Kanazawa Univ. (Japan). Coll. of Liberal Arts); Sato, Masatoshi; Morii, Yukio; Funahashi, Satoru. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Powder neutron diffraction patterns of $Pb_2Sr_2YCu_3O_{8+\delta}$ (δ = 0.0 and 1.67) were analyzed by Rietveld method. For δ = 0, it had been indicated, by powder X-ray diffraction, that the structure was a monoclinic one. The R factors of the present analysis for the monoclinic structure were about 3/4 of those for the previous orthorhombic ones. The structure was almost the same as the previous X-ray result except z (02). For the annealed phase, the tetragonal and the orthorhombic structures had been presented by X-ray diffraction and by neutron diffraction, respectively. The R factors of the present analysis for the orthorhombic structure were about 5/6 of those for the tetragonal structure. The distance between the Pb plane and the oxygen deficient Cu plane was found to become larger in proportion to δ, though there occurs a phase separation in low δ region. (author).

23025 (JAERI-M–93-228, pp. 447-454) **Magnetic order in ternary compounds $TbMn_2Ge_2$ and $TbMn_2Si_2$.** Purwanto, Setyo (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Ohashi, Masayoshi; Onodera, Hideya; Yamauchi, Hiroshi; Yamaguchi, Yasuo; Morii, Yukio; Funahashi, Satoru. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

High resolution powder diffraction studies were made on the rare-earth compounds $TbMn_2Ge_2$ and $TbMn_2Si_2$ with the body-centered tetragonal structure of the $ThCr_2Si_2$ type. For $TbMn_2Ge_2$, two magnetically ordered phases were observed. In the temperature range of Tc = 95.3 K < T < T_N = 414 K, Mn moments are only coupled antiferromagnetically along the c-axis. At Tc = 95.3 K, Tb moments become abruptly order in collinear ferrimagnetic state, Tb and Mn comments are coupled antiparallel to each other along the c-axis, and keep the same magnetic structure down to 8 K. These results support the Shigeoka's report but make a denial of the magnetic transition and structure proposed by the Leciejewicz and a Szytula. $TbMn_2Si_2$ takes canted-ferrimagnetic structure below T_{c1} = 54.3 K with a tilting angle 42deg from the c-axis at 6 K for Mn atoms while Tb moments are parallel to the c-axis (90 μ_B/Tb and 1.8 μ_B/Mn at 6 k). In the temperature range from T_{c1} = 54.3 K to T_{c2} = 64.5 K, $TbMn_2Si_2$ exhibits a moment modulation structure of wave vector k = [0,0,0.666]. Higher than 64.5 K to T_N = 550 K, only Mn moments coupled antiferromagnetically. (author).

23026 (JAERI-M–93-228, pp. 455-462) **Neutron powder diffraction study on $Nd_2Fe_{17}N_xH_y$ with $0 \leq x < 3.0$ and $0 \leq y < 1.0$.** Kajitani, Tsuyoshi (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Kato, Hiroaki; Nakagawa, Yasuaki; Hiraga, Kenji; Morii, Yukio; Funahashi, Satoru; Iriyama, Takahiko; Kobayashi, Kurima. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Present work was aimed to elucidate crystal structure of nitrogenated Th_2Zn_{17}-type rare-earth metal and iron intermetallic compound hard magnets. For successful neutron diffraction work, neodymium-iron-system was chosen. High-resolution neutron powder diffraction measurements with λ = 1.8232 A and collimation of 6'-20'-6' on the title compounds were carried out in the temperature range from 13-14K to room temperature. Nitrogenated samples were charged in NH_3 + H_2 mixed gas at 465degC. Coexistence of nitrogen and hydrogen atoms was noticed in the highly gas-charged samples. The maximum nitrogen and hydrogen contents are estimated as $N_{3.0}$ and $H_{1.0}$ per unit chemical formula, Nd_2Fe_17. Nitrogen and hydrogen atoms are located preferentially in 9e (1/2 0 0)-site and 18 g (x 2/3 1/6)-site with x $\approx$ 0.2, respectively. The lattice constants-temperature dependencies of the nitrogen/hydrogen free Nd_2Fe_{17} exhibited appreciable anomaly below Curie temperature. (author).

23027 (JAERI-M–93-228, pp. 463-467) **Incoherent neutron scattering of hydrogen bond compounds: 1. Experiments at steady reactor.** Noda, Yukio (Chiba Univ. (Japan). Faculty of Science); Tamura, Itaru; Ikeda, Susumu; Yamada, Yasusada. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Incoherent neutron scattering experiments of KH_2PO_4 and $K_3H(SO_4)_2$ were performed in order to study the role of the hydrogen dynamics for the isotope effect in hydrogen bond materials. Experiments were carried out under the collaboration between the pulse neutron source (KENS) and the steady reactor source (JRR-3M), and this paper will report the part of the experimental results taken at JRR-3. Precise temperature dependences of elastic and inelastic incoherent neutron scattering were measured. The elastic scattering of KH_2PO_4 along a-direction apparently increased and the inelastic component decreased at Tc. The Q-dependence of the change at Tc of the elastic intensity as well as that of inelastic intensity at Δ E = -5 meV show a broad peak around 5 to 7 A-1. The analysis of inelastic scattering profiles gives the extraordinary broad width. Even when the existence of the tunneling mode is assumed, the characteristic energy is 1.1 meV and the width (FWHM) is 24 meV, which is different from the assumed tunneling state. Thus, the motion of hydrogen atoms seems to have a stochastic character. The incoherent scattering profile of $(K_3H(SO_4)_2$ shows an inelastic component but no drastic change was observed as a function of temperature since this compound has no phase transition temperature. These results are completely consistent with the results given by the pulse neutron experiments. (author).

23028 (JAERI-M–93-228, pp. 468-474) **Structure of martensitic phase and phonon instability in $Cu_{61}Zn_{39}$.** Konishi, Akio (Chiba Univ. (Japan). Faculty of Science); Kuroiwa, Yoshihiro; Noda, Yukio. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

In order to study the mechanism of the martensitic phase transformation in $Cu_{61}Zn_{39}$, neutron elastic and inelastic scattering experiments were performed at JRR-2 and JRR-3M of JAERI and HFIR or Oak Ridge National Laboratry. Measurements of phonon dispersion curve indicate that the entire TA_2[110] phonon mode is extremely soft and shows further softening on decreasing temperature. However, no anomalies in dispersion relations found in other directions studied. The structure of the martensite phase was investigated by using a WAND spectrometer on (HHL) and (HKO) planes. Analysis of two-dimensional intensity data indicates that the structure of martensite phase in $Cu_{61}Zn_{39}$ is slightly different from the 9R' structure reported by Tadaki et al. We propose a mixed phase of a distorted CsCl structure and a three-period lattice as the structure of martensite phase. (author).

23029 (JAERI-M–93-228, pp. 475-477) **Magnetic structure of itinerant electron antiferromagnets $Mn_{3-x}T_xSi$(T = Cr, Fe).** Miki, Hiroyuki (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Ohoyama, Kenji; Yamaguchi, Yasuo; Funahashi, Satoru;

Tomiyoshi, Shoichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Magnetic and crystallographic structures of $Nm_{3-x}T_xSi$(T = Cr,Fe) system are studied by means of X-ray and neutron diffraction measurements. The results indicate that all these alloys crystallize to the $L2_1$ (Heusler) structure and show antiferromagnetic properties. Using the nuclear scattering data, the site preference of substituted elements (T) is obtained that Cr enters predominantly the site with eight Mn first near neighbors and Fe enters the other site which has four Mn and four Si first near neighbors. The values of magnetic moment were calculated Tomiyoshi model, which assumed the transversal sinusoidal spin ordering with the wave vector q being parallel to the [111] axis. From this model we conclude the structure that the magnetic moments are in the (111) plane, except for y = 1.2 that is along the [111] direction. Incommensurate spin density wave is observed to be stable for the concentration range of $0 \leq x \leq 0.1$ and $0 \leq y \leq 0.1$. (author).

23030 (JAERI-M–93-228, pp. 479-485) **Inelastic neutron scattering measurements on hydrogen-involved molecular librations in superconducting κ-$(h_8$-BEDT-TTF$)_2Cu(NCS)_2$.** Toyota, N. (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Kajitani, T.; Shimazu, T.; Shibata, K.; Sasaki, T.; Lang, M.; Ikeda, S. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

TOF inelastic neutron scattering measurements using LAM-D spectrometer on a superconducting (Tc = 10K) organic salt, κ-$(h_8$-BEDT-TTF$)_2Cu(NCS)_2$ are performed to study hydrogen-involved molecular librations. The generalized partial density-of-state (GPDOS)spectrum consists of a broad peak in the low energy regime, 0 - 25 meV, and two rather sharp peaks centered at 32 meV and 56 meV. The latter peaks, which are also observed in the neutral BEDT-TTF crystal, can be well assigned to hydrogen-involved librations previously calculated and measured in infrared and Raman spectroscopies by Kozlov et al. These peak intensity exponentially increases with decreasing temperature down to 18 K, followed by a sudden drop at 6 K below Tc. Alternatively there appear, at 6 K, new low-lying states with three distinct peaks centered at about 2, 4 and 8 meV. These energy range is comparable to the superconducting energy gap of 3.5-4.0 meV, suggesting that these hydrogen-involved molecular librations might be strongly coupled to superconductivity. (author).

23031 (JAERI-M–93-228, pp. 486-491) **[110]TA_1 phonon dispersion relations of BCC, B2 and Heusler phases in $AuCuZn_2$ alloy.** Nagasawa, A. (Nara Women's Univ. (Japan). Dept. of Physics); Yamauchi, R.; Makita, T.; Morii, Y.; Funahashi, S. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The present study by neutron inelastic scattering experiments reveals that characteristics of the [110]TA_1 phonon dispersion relation in the Heusler phase region are never transmitted to either the B2 phase or the bcc phase. The lattice instability towards the 18 R martensite begins to occur after the Heusler ordering is completed at about 670 K. Anomalous elastic peak appearing near $2/3[110]q_{max}$ is also studied in a wide range of temperature: we make clear that the peak is due to a certain kind of regular arrangement of vacancies in the B2 phase, as is the case of the ω-like peak in this alloy. (author).

23032 (JAERI-M–93-228, pp. 492-499) **High pressure neutron diffraction studies of the magnetic structures of Tb, Ho and Er.** Kawano, Shinji (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Achiwa, Norio; Onodera, Akifumi; Nakai, Yutaka; Lebech, Bente. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Pressure effects of the magnetic structures of Tb, Ho and Er have been studied by neutron diffraction using a newly-developed clamp type pressure cell. For Tb the pressure dependence of the turn angle in a helical phase shows an enhancement of its value, particularly in low temperatures with increasing pressure but no lock-in feature. Linear coefficients of the magnetic transition temperatures to pressure are obtained. For Ho the turn angle is increased by pressure and shows an almost linear temperature dependence at high temperatures and lock-in features at low temperatures. For Er the high pressure results reveal that the transition to a conical structure at low temperatures is suppressed and that a cycloidal structure with a modulation vector $Q = 2/7(2\pi/c)$ persists down to 4.5 K, similar to a three up four down structure in Tm. (author).

23033 (JAERI-M–93-228, pp. 500-504) **Neutron quasi-elastic scattering study of magnetic fluctuations in Yb monopnictides.** Ohoyama, Kenji (Tohoku Univ., Sendai (Japan). Dept. of Physics); Kohgi, Masahumi; Osakabe, Toyotaka; Oyamada, Akira; Suzuki, Takashi; Otomo, Toshiya. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

We present results of an investigation of spin dynamics of the semimetallic Kondo compounds YbX (X = N, P, As) by neutron quasi-elastic scattering (QES) experiments. The spin dynamics in YbX is found to be essentially the same independent of X. The crossover of QES spectra from Gaussian-like form to Lorentzian-like one occurs around 150 K with the increase of temperature. This crossover behavior indicates that the spin fluctuations at low temperature region are governed by the RKKY type interatomic exchange interactions, but the single site relaxation process becomes important at higher temperatures. It is concluded that the Kondo effect suppresses strongly the magnetic long range ordering in YbX. (author).

23034 (JAERI-M–93-228, pp. 505-508) **Neutron scattering study of $Ce_3Au_3Sb_4$.** Kasaya, Mitsuo (Tohoku Univ., Sendai (Japan). Dept. of Physics); Katoh, Kenichi; Kohgi, Masahumi; Osakabe, Toyotaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Rare-earth compounds with an $Y_3Au_3Sb_4$-type crystal structure are semiconductors or semi-metals. Among them, $Ce_3Au_3Sb_4$is a semiconductor with an activation energy of about 640 K and shows no magnetic order down to 1.5 K. The magnetic part of the specific heat for $Ce_3Au_3Sb_4$ obtained by subtracting the value for $La_3Au_3Sb_4$ from the total specific heat of $Ce_3Au_3Sb_4$ shows a broad peak at around 10 K, the origin of which is well explained by the crystalline-field splitting determined by neutron scattering. (author).

23035 (JAERI-M–93-228, pp. 509-513) **Phonon dispersion anomaly in the premartensitic β_1-phase Au-Zn alloys.** Makita, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Office of Synchrotron Radiation Facility Project); Ohno, H.; Nagasawa, A.; Morii, Y.; Funahashi, S. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research:*

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Transverse acoustic phonon dispersion relations along the [110] axis (e//[110]) in binary Au-Zn alloys were measured at 293,150 and 110 K by means of triple-axis neutron spectrometer installed in JRR-3M. Each dispersion relation curve was observed to have the anomalous dip. Phonon energy decreased with decreasing temperature. The effective interplaner force constants between the origin and nth neighbor atomic planes Φ_n's were determined through the least-squares fitting analysis on the phonon dispersion curves (N = 1, 2 and 3). The Φ_2's were negative, while Φ_3's were positive. As temperature decreased, Φ_2's became smaller, but Φ_3's became larger. This means that the (110) planes of the second nearest neighbors are not coupled with each other, and the third nearest ones are strongly coupled. Thus the stacking structure with a periodic unit of three layers is considered to form. The dips appearing on the [110]TA_1 phonon dispersion curves mainly originated from a characteristic combination of Φ_2 and Φ_3 in the β_1 phases. It was concluded that lattice dynamical precursor in the premartensitic β_1 state causes the change of Φ_2 and Φ_3. (author).

23036 (JAERI-M–93-228, pp. 514-521) **Structural phase transition and superconductivity in $La_{2-x}Ba_xCuO_4$.** Katano, Susumu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Funahashi, Satoru; Fernandez-Baca, J.A.; Mori, Nobuo; Murayama, Chizuko; Ueda, Yutaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

High-resolution neutron powder diffraction experiments and ac magnetic susceptivility measurements have been performed on $La_{2-x}Ba_xCuO_4$ (x = 0.125) at ambient pressure and under high pressures. Crystal parameters including bond lengths and angle are refined by profile analysis at ambient pressure. The results suggest that the changes in the Cu-O bonds accompanied with the structural phase transition may be related to the suppression of the superconductivity. The effects of pressure on the structural transition is fairly large. The LTT phase is greatly suppressed, and disappears at 0.7 GPa. The superconducting transition temperature T_c remains almost constant up to 0.5 GPa; however, above this pressure it increases at the rate of about 10 K/GPa. These results clearly indicate a strong correlation between the crystal structure and the superconductivity in this system. (author).

23037 (JAERI-M–93-228, pp. 522-529) **Diffraction study on the nonstoichiometric α-U_2N_{3+x} phase.** Serizawa, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Fukuda, K.; Ishii, Y.; Funahashi, S.; Katsura, M. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

X-ray and neutron diffraction studies were performed on nonstoichiometric α-$U_2N_{3+}x$ having a composition range $1.68 < N/U < 1.84$. It was confirmed that the crystal structure of αU_2N_{3+x} in this composition range was distorted Mn_2O_3-type. Structure parameters of U and N atoms were determined. The results showed that positions of U atoms varied continuously with nitrogen content. No evidence of the modification from bcc to fcc could be obtained. Interatomic distances of U-U and U-N were determined. The position parameter of N atoms showed that N atoms were slightly deviated from the tetrahedral site. (author).

23038 (JAERI-M–93-228, pp. 532-539) **Refinement of phonon eigenvector phases from intensities of neutron inelastic scattering in Si.** Kulda, Jiri (Institut Max von Laue-Paul Langevin, Grenoble (France)); Strauch, Dieter; Ishii, Yoshinobu. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The [111] direction in diamond structure is one of the simplest cases where the phonon polarization vectors are not fully determined by symmetry. For the longitudinal phonons there appears a phase shift between the motions of the two sublattices which can be observed only via the intensities of neutron coherent inelastic scattering. In order to minimize experimental errors in their determination we have employed a new strategy, analogous to those utilized in crystallography: we have measured at a given energy transfer the intensities due to two different longitudinal acoustic phonon branches([00ξ]and [$\xi\xi\xi$]) in various Brillouin zones and the unknown phase was then refined together with a scale factor from the observed inelastic structure factors. When comparing the resulting phase variation within a Brillouin zone with the prediction of the bond charge model calculations a slight deviation is found at $\xi > 0.25$ which may stimulate further theoretical work. (author).

23039 (JAERI-M–93-228, pp. 547-554) **Small angle neutron scattering study on a phase separation in a 3-component microemulsion system.** Seto, Hideki (Hiroshima Univ., Higashihiroshima (Japan). Faculty of Integrated Arts and Sciences); Yokoi, Eiji; Komura, Shigehiro; Schwahn, Dietmar; Mortensen, Kell; Suzuki, Junichi; Funahashi, Satoru; Ito, Yuji. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The mixture of three components, water, n-decane and 2-ethylhexylsulfosuccinate (AOT), is a well-known system that forms a 'water-in-oil' microemulsion at room temperature and decomposes with increasing temperature, thereby being associated with a critical phenomenon. Experimental results in previous literature, indicate that the phenomenon is interpreted to be that of the 3D-Ising, but we obtained the meanfield behavior of the susceptibility at 'near-critical region' by a small angle neutron scattering. The observed spinodal and binodal points were well explained assuming the van der Waals free energy expression. (author).

23040 (JAERI-M–93-228, pp. 555-562) **Neutron diffraction from lead germanate glasses.** Umesaki, Norimasa (Government Industrial Research Inst., Osaka, Ikeda (Japan)); Brunier, T.M.; Wright, A.C.; Hannon, A.C.; Scinclair, R.N. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

High resolution neutron diffraction data have been collected on the PbO-GeO_2 glasses and on GeO_2 for comparison. These neutron data have revealed the existence of 6-fold coordinated germanium (GeO_6 octahedra) by virtue of the shift in the first peak in the obtained total correlation function T(r) and increase in the coordination. The neutron results also indicate that PbO exits as PbO_4 pyramids, as found in the orthorhombic form of PbO crystal, in the studied PbO-GeO_2 glasses. (author).

23041 (JAERI-M–93-228, pp. 578-585) **Microscopic view of the volume phase transition on weakly charged temperature sensitive polymer gels.** Shibayama, Mitsuhiro (Kyoto Inst. of Tech. (Japan)); Tanaka, Toyoichi; Han, C.C. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The static structure factor, I(q), for poly(N-isopropylacrylamide-co-acrylic acid) (NIPA/AAc) gels was investigated in terms of small-angle neutron scattering (SANS), where q is the magnitude of the scattering vector. The static structure factor for NIPA/AAc

gels was well described by a Lorentz type scattered intensity function at temperatures below 34degC which was near the so-called Θ temperature of NIPA in D_2O. At higher temperatures, the static structure factor had a distinct scattering maximum although the gel was still in a highly swollen state. The scattering maximum was located around $q = 0.02A^{-1}$ and was temperature and concentration dependent. The appearance of the peak indicates strong concentration fluctuations in the system. The static structure factors were analyzed quantitatively with the theory of Borue and Erukhimovich [Macromolecules, 1988, 21, 3240] for polyelectrolyte solutions in a poor solvent. (author).

23042 (JAERI-M–93-228, pp. 586-591) **Diffractometer for neutron crystallography in biology: Japanese project.** Niimura, Nobuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Since the structure-function relationship of proteins is dominated by the behavior of hydrogen atoms, it is important to know the structural information of hydrogen atoms. Neutron diffraction provides an experimental method of directly locating hydrogen atoms. So, we have had a project to construct the dedicated diffractometer for the neutron crystallography in biology at JRR-3M in JAERI (Japan Atomic Energy Research Institute). The diffraction intensity from the protein crystal is weaker than that from most of inorganic materials. In order to overcome the intensity problem, three items should be considered carefully. Those are (1) how to get a large single crystal, (2) how to get intense neutron flux on a sample position, and (3) how to get a genuine detector system. (author).

23043 (JAERI-M–93-228, pp. 592-598) **Structure study for the complex of HU protein and DNA.** Tanaka, Ichiro (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Niimura, Nobuo; Tanaka, Isao; Kataoka, Mikio; Mihara, Ken-ichi; Tokunaga, Fumio; Mita, Kazuei. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The small angle X-ray and neutron scattering experiments have revealed the structure of the complex of DNA-binding protein HU and DNA with 20 base pair long in solution. By comparing observed Rg(Radius of gyration) of the complex with calculated Rg of the model, we have concluded that HU protein binds DNA in such a manner that the protein bends the rod-like DNA, and that the binding is rather cooperative. This is the first evidence on the structure of HU-DNA complex obtained by the diffractive method in vitro. These findings give us the view that HU protein might facilitate the DNA's dynamical reactions in a cell by winding DNA like an enzyme, and that there might been a possibility that cells turn on and off the enzymatic actions by changing the concentration of HU protein. (author).

23044 (JAERI-M–93-228, pp. 599-603) **Small angle neutron scattering study of the initial stage of lysozyme crystallization process.** Minezaki, Yoshiaki (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Tanaka, Ichiro; Niimura, Nobuo; Ataka, Mituo; Katsura, Tatsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Despite the enormous amount of information obtained from atomic resolution crystal data, the difficulties encountered in growing crystals preclude structural X-ray studies for the majority of known isolated proteins. The protein crystal growth process can be studied by electron microscopy and by light scattering, and recently Ataka and Asai have discussed the kinetics on lysozyme crystal growth. We have conducted small angle neutron scattering (SANS) experiments on the time evolution from the initial stages to the visible size of crystallization of hen egg-white lysozyme. SANS from several kinds of solutions have been carried out. The SANS result showed the distinctive change of time evolution. We have also conducted the experiments under various unsaturated conditions using SANS. From these experiments, we found that even under unsaturated conditions, aggregation of lysozyme was found to be started, against the result of light-scattering experiments. (author).

23045 (JAERI-M–93-228, pp. 604-611) **Phase transitions and structures of methylammonium compounds.** Yamamuro, Osamu (Osaka Univ., Toyonaka (Japan). Faculty of Science); Onoda-Yamamuro, Noriko; Matsuo, Takasuke; Suga, Hiroshi; Kamiyama, Takashi; Asano, Hajime; Ibberson, R.M.; David, W.I.F. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The structures of CD_3ND_3Cl, CD_3ND_3I, $CD_3ND_3BF_4$, $(CD_3ND_3)_2SnCl_6$, and $CD_3ND_3SnBr_3$ crystals were studied with time-of-flight type high-resolution powder diffractometers using spallation pulsed neutron sources. The orientations of the CD_3ND_3 cations, including the positions of the D atoms, were determined at all the room temperature phases and at the low temperature phases of CD_3ND_3I and $(CD_{3N}D_3)_2SnCl_6$. The heat capacity experiments were also performed for both protonated and deuterated analogs of these compounds. From both structural and thermodynamic points of view, it was found that the transitions are mainly associated with the order-disorder change of the orientations of the CD_3ND_3 cations. (author).

23046 (JAERI-M–93-228, pp. 612-619) **Structure and dynamics of aqueous electrolyte solutions by neutron scattering.** Yamaguchi, Toshio (Fukuoka Univ. (Japan). Faculty of Science); Yamagami, Motoyuki; Wakita, Hisanobu; Takamuku, Toshiyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Neutron isotopic substitutuion measurements have been performed in a temperature range of 90-474 K on a concentrated D_2O solution of lithium chloride using ^7Li, ^0Li (mixture of ^6Li and ^7Li), ^{35}Cl, and ^{37}Cl. The radial distribution functions obtained have revealed temperature dependent hydration structures of Li^+ and Cl^-. The isomorphic substitution technique has been successfully applied to aqueous perchlorate solutions of Pr^{3+}-Nd^{3+}, Tb^{3+}-Dy^{3+}, and Tm^{3+}-Yb^{3+}; the results have demonstrated a detailed coordination geometry of water molecules around the lanthanide (III) ions and a change in hydration number in the lanthanide series. The dynamic properties of water molecules in concentrated aqueous solutions of lithium chloride and zinc(II) bromide have been investigated at ambient temperature and in the supercooled state, the neutron quasi-elastic scattering method. The self-diffusion coefficients of water molecules are determined and discussed on the basis of the jump-diffusion model. The results from the neutron scattering methods are compared with those obtained from comparative X-ray diffraction, pulsed field gradient, nuclear magnetic relaxation measurements. (author).

23047 (JAERI-M–93-228, pp. 620-626) **Ion dynamics in molten alkali metal nitrates.** Kamiyama, Takashi (Hokkaido Univ., Sapporo (Japan). Faculty of Science); Nakamura, Yoshio; Shibata, Kaoru; Suzuki, Kenji. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Quasielastic neutron scattering experiments have been performed on simple molten alkali metal nitrates, $RbNO_3$ and $LiNO_3$. The experiments were carried out by the medium resolution inverted geometry spectrometer LAM-40 at KENS neutron scattering facility in Japan. The measured spectra are composed of narrow and broad quasielastic spectra. We assigned that the broad component corresponds to the fast intra-ionic motions in a nitrate ion. From momentum dependence of integrated intensity for this component it is found that the motion of nitrate ions in $RbNO_3$ melt is mainly the librational one centered C_3 axis on the ion. On the other hand the intra-ionic motion in $LiNo_3$ is the librational motion cnetered C_3 axis on the nitrate ion which amplitude is smaller than in $RbNO_3$ melt. This fact shows that the motion of nitrate ions in $LiNO_3$ is restricted strongly by surrounding cations. (author).

23048 (JAERI-M–93-228, pp. 627-634) **Double crystal diffractometer arrangement for very small angle neutron scattering with PNO in JRR-3M.** Aizawa, Kazuya (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Tomimitsu, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The status of a double crystal diffractometer (DCD) for very small angle neutron scattering (VSANS), which is arranged in the precise neutron optics (PNO) apparatus on 3G beam hole at JRR-3M, is presented. The DCD consists of nondispersive (1,1) setting of perfect silicon single crystals with a sample between two crystals and is set in a constant temperature chamber. The first crystal is set on a normal goniometer and acts as a horizontal beam collimator. The second crystal is set on a precise goniometer of which the smallest control step size is 5×10^{-3} sec of arc, and acts as an analyzer for VSANS. The 111 symmetric reflection is used for both crystals. A measurement of silica spheres reveals that the q-range is available between 2×10^{-4} and 3×10^{-2} mm^{-1}, which covers up to μm in real space. (author).

23049 (JAERI-M–93-228, pp. 635-640) **Phase separation and ordering process in Al-Li alloys studied by small-angle neutron scattering and neutron diffraction.** Furusaka, M. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Fujikawa, S.I.; Tranquada, J.M. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

To study phase separation kinetics of Al-9.5at%Li polycrystalline alloys in which precipitates have ordered $Al_3Li(\delta')$ structure, profile analysis of small-angle neutron scattering and superlattice reflections {100} and {110} were done. A small-angle scattering instrument and a triple-axis spectrometer in elastic mode were used in the measurements. Strong texture was observed in the reflections. Therefore, measurements were done using the crystal orientation where the intensity of the reflection was at the maximum. Profiles of small-angle scattering and superlattice reflections were almost identical at higher momentum transfer side. At lower momentum transfer side, small-angle scattering showed interference effects, but superlattice reflection did not show any sign of the interference. Integrated intensities of superlattice reflections were obtained, and compared with the small-angle scattering intensity. The order parameter was not saturated in the δ' precipitates at the early stage of the pahse separation process. (author).

23050 (JAERI-M–93-228, pp. 647-652) **Small angle neutron scattering study of silica suspensions.** Kimura, Yoshinobu (Mie Univ., Tsu (Japan). Faculty of Engineering); Kawaguchi, Masami; Suzuki, Jun-ichi; Funahashi, Satoru; Izumi, Yoshinobu. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Two types of silica were used: one is Aerosil-130 silica, which is easily aggregated in water and the other is Snowtex-C dispersed in water. These silicas were mixed with an aqueous solution of hydroxypropyl methyl cellulose (HPMC) that adsorbs on the silica surfaces to make silica suspensions. Small angle neutron scattering (SANS) technique was used to understand the structures and interactions of the silica suspensions and the corresponding silica slurries (no HPMC) as functions of HPMC and silica content. The wave vector q was ranged 0.03 to 0.8 nm^{-1}. In the scattering curves for Aerosil silica slurries and suspensions below $q = 0.1$ nm^{-1}, a power-law exponent of 2.1 was obtained independent of silica content. The scattering curves at higher q, however, approached a power-law scattering with an exponent of -4, namely followed the Porod's law. It was found that adsorption of HPMC did not effect on the scattering curves. On the other hand, for Snowtex-C the peak was observed at the intermediate q in the scattering curves, whose position shifts to higher q with an increase in silica content, indicating that an average distance between silica particles decreases. Snowtex-C suspensions showed an increase in scattering intensity below $q = 0.1$ nm^{-1} by adsorption of HPMC. (author).

23051 (JAERI-M–93-228, pp. 653-658) **Chain conformations of ABA triblock copolymers in microphase-separated structures for SANS.** Matsushita, Y. (Nagoya Univ. (Japan). Faculty of Engineering); Nomura, M.; Watanabe, J.; Mogi, Y.; Noda, I.; Han, C.C. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Single chain conformations of center block, polystyrene, of poly(2-vinylpyridine-b-styrene-b-2-vinylpyridine)(PSP) triblock copolymers of the ABA type in bulk were measured by small angle neutron scattering (SANS), while microphase separation structures were studied by small angle X-ray Scattering (SAXS) and transmission electron microscopy (TEM). From the morphological observations, PSP block copolymers have confirmed to have alternating lamellar structure both when $\phi s = 0.33$ and $\phi s = 0.5$, where ϕs is the volume fraction of polystyrene blocks. It was also clarified that the chain dimension of center blocks of sample with $\phi s = 0.33$ is smaller than that of sample with $\phi s = 0.5$. This result may mean that the center blocks have bridge-righ conformation when $\phi s = 0.33$ while they have loop-rich conformation when $\phi s = 0.5$. (author).

23052 (JAERI-M–93-228, pp. 659-665) **Chain conformations of the component polymers and the microphase separation structures of homopolymer/block coplymer blends.** Torikai, Naoya (Nagoya Univ. (Japan). Faculty of Engineering); Mogi, Yasuhiro; Matsushita, Yushu; Noda, Ichiro; Han, C.C. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Microdomain spacings of lamellar structures formed by styrene homopolymer/styrene-2-vinylpyridine diblock copolymer/2-vinylpyridine homopolymer blends were measured by small-angle X-ray scattering (SAXS) and single chain conformations of block copolymers in the same blend system were measured by small-angle neutron scattering (SANS). The molecular weight of diblock copolymers is 78K-72K, and three kinds of styrene homopolymer (S_H) and 2-vinylpyridine homopolymer (P_H) pairs were blended, their molecular weight ratios to that of host block chains were 0.17, 0.38, and 0.78, respectively. Two blend ratios of homopolymer (H)/block copolymer (B), i.e. 1/2 and 1/1 were examined. It was found that the domain spacings of all blends are larger than that of pure block copolymer and that they are increasing with increasing the molecular weight of homopolymers and/or with increasing the volume fraction of homopolymers. Further, block chains in the blends were confirmed to have almost the same chain dimension as that

of block chain in pure block copolymer system in the direction parallel to the domain interface irrespective of molecular weight and volume fraction of homopolymers. (author).

23053 (JAERI-M–93-228, pp. 666-672) **Neutron diffraction studies of molten Tl- and Bi-Se alloys.** Usuki, Takeshi (Niigata Univ. (Japan)); Shirakawa, Yoshiyuki; Tamaki, Sigeru; Inui, Masanori; Takeda, Shin-ichi; Sugiyama, Kazumasa; Waseda, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Neutron diffraction studies on the molten Tl-Se and Bi-Se systems have been carried out over the wide concentration range. Profiles of the total structure factors or the pair distribution functions of both systems are essentially similar to those of pure liquid metals in metal-rich range, suggesting that the additional Se atoms are almost substituted with the metal atoms and they might form a certain short range order, because of the difference in the electronegativities of the constituents. The Bi-Bi configuration which is close to that of pure liquid Bi still remains in the Se-rich range. The existence of covalent-type Se polymeric structure is recongnized in Se-rich composition range on the molten Tl-Se system. We have also derived the partial structure factors, using three different total structure factors in a small concentration range, where the partial structure factors were assumed to be constant. (author).

23054 (JAERI-M–93-228, pp. 673-678) **Neutron diffraction of molten noble metal halides.** Shirakawa, Yoshiyuki (Niigata Univ. (Japan)); Usuki, Takeshi; Tamaki, Shigeru; Inui, Masanori; Takeda, Shinichi; Sugiyama, Kazumasa; Waseda, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Neutron diffraction experiments have been applied for molten CuCl-CuBr and AgBr-AgI system along the liquidus curve. For molten $CuCl_xBr_{1-x}$ mixtures, the contraction of the interionic distance are found at x = 0.25 and 0.75. These results are consistent with those found in the magnetic susceptibilities for this system. Molten $AgBr_xI_{1-x}$ mixture shows an expansion of the interionic distance in their concentration dependence. (author).

23055 (JAERI-M–93-228, pp. 679-687) **Vesicle formation in the block copolymer/homopolymer mixture studied by scattering methods.** Koizumi, Satoshi (Kyoto Univ. (Japan). Faculty of Engineering); Hasegawa, Hirokazu; Hashimoto, Takeji; Suzuki, Junnich. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

We studied morphology and spatial segmental distribution of particular binary mixtures of poly(styrene-block-isoprene)(SI) and homopolystyren, either protonated (HS) or deuterated (DS), with small angle-X-ray scattering (SAXS) and neutron scattering (SANS). The block copolymer SI used itself had a lamellar microdomain. Molecular weights of HS and DS were identical to each other and equal also to that of polystyrene block (PS) in SI. SAXS results obtained for SI and HS mixtures show that: (1) HS is solubilized in the PS microdomains; (2) the polyisoprene lamella has the thickness independent of w_{HS}, weight fraction of HS, but its undulation depends on w_{HS}. These two findings, in turn, imply that the HS added is localized in the middle of the PS microdomains, i.e., in between the PS brushes emanating from the interface of SI. We further confirmed this implication by SANS with a deuterium labeling technique; the DS segments studied for the SI/DS mixture is localized in the middle of PS microdomain with the penetration depth of 10 nm between DS and PS block chains. (author).

23056 (JAERI-M–93-228, pp. 688-693) **Inversion of the phase diagram in polymer blends studied by small-angle neutron scattering.** Jinnai, Hiroshi (Kyoto Univ. (Japan). Faculty of Engineering); Hasegawa, Hirokazu; Hashimoto, Takeji; Han, C.C. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The miscibility of an amorphous mixture of normal (protonated) polybutadiend (HPB) and perdeuterated polybutadiene (DPB) has been extensively studied and was characterized by an upper critical solution temperature (UCST). In this study the miscibility of HPB and DPB as a function of temperature was studied by small-angle neutron scattering (SANS). The vinyl component of the DPB was held constant at 16%, while the vinyl frantion of the HPB was varied from 17-80%. The binary interaction parameter, χ, was obtained. The mixtures of DPB and HPB with 17-39% vinyl show UCST behaviors; i.e., χ increases with decreasing temperature. The mixture of DPB and HPB with 52% vinyl was found to have almost no temperature dependence. However, the mixture of DPB and HPB with 65-80% show a lower critical solution temperature (LCST) behavior; i.e., χ increases with increasing temperature. This inversion of the phase diagram from UCST to LCST has never been observed. (author).

23057 (JAERI-M–93-228, pp. 694-698) **Small-angle neutron scattering study of amorphous Si-Ti-C-O fibers.** Suzuya, Kentaro (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Kamiyama, Tomoaki; Ito, Yuji; Okamura, Kiyohito; Suzuki, Kenji. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

A small-angle neutron scattering (SANS) study of amorphous Si-Ti-C-O-fibers was performed using SANS-U spectrometer at JRR-3. Anisotropically scattered strong intensities were observed in the direction perpendicular to the fiber-axis. These are caused by scattering entities with a well-defined boundary. The size of the scattering entities is considerably large. The measurements were made for the fibers suspended in the air and in D_2O solvent and show that the fibers have two kinds of scattering entities, one is concerned in the surface irregularities of the fibers and another is concerned in some fluctuation of the structure of the fibers. The integrated intensity of the surface part of the neutron scattering is stronger than that of the inner part about by 2.7 times. (author).

23058 (JAERI-M–93-228, pp. 699-703) **Small angle neutron scattering study of phase separation in PMMA/SAN.** Ohishi, Yasuo (Sumitomo Chemical Co. Ltd., Osaka (Japan)); Uemura, Akio; Minobe, Masao; Fuchizaki, Kazuhiro; Suzuki, Junichi; Funahashi, Satoru. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

A time-resolved small angle neutron scattering study has been made by utilizing a new Small Angle Neutron Scattering (SANS) machine installed at JRR-3M to investigate the phase separation kinetics in a polymer alloy, poly(methylmethacrylate)/poly(styine-co-acrylonitorile). This polymer alloy has a lower critical solution temperature, hence the scattered intensity was measured at the two-phase field after a temperature jump above the phase boundary from the miscible state. By observing the time evolution of scattered intensities, several stages changing phenomena of the spinodal decomposition have been detected. In the early stage the characteristic behavior that the maximum scattered intensity I_m is increasing with time while the wave number Q_m giving rise to the maximum intensity is kept constant has been clearly observed.

Here Q_m was found to be equal to Rg^{-1} where Rg is the gyration radius of the polymer chain. It should be emphasized that in addition to this observation we have succeeded in detecting the decomposition process in the veyr early time. The observed power law in this stage is discussed together with a recent theoretical prediction. (author).

23059 (JAERI-M–93-228, pp. 704-708) **Low-energy modes and medium-range correlated motions in $Pd_{79}Ge_{21}$ alloy glass.** Shibata, Kaoru (Tohoku Univ., Sendai (Japan). Inst. for Materials Research); Mizuseki, Hiroshi; Suzuki, Kenji. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

It is well known that there are excess modes over the sound wave in low energy region below about 10 meV in glass materials, which do not exist in corresponding crystalline materials. We examined the low energy modes in a $Pd_{79}Ge_{21}$ alloys glass by means of inelastic neutron scattering. Measurements were performed on the crystal analyzer type time-of-flight spectrometer LAM-40 with PG(002) and Ge(311) analyzer mirror, which is installed at KENS. The dynamic structure factor $S(Q,\omega)$ was obtained over the wide momentum range from 0.5 to 5.2A^{-1}. The measured $S(Q,\omega)$'s have almost same momentum (Q) dependence at each energy ($\hbar\omega$) in the energy range from 2.0 to 8.0 meV. In the energy region below 3 meV, we found a small shoulder peak at Q = 1.7A^{-1} in the momentum dependence of $S(Q,\omega)$. It corresponds to a prepeak in S(Q). Therefore it is concluded that the low energy modes in $Pd_{79}Ge_{21}$ alloy glass is mainly contributed from medium-range correlated motions in the cluster consisting of a few chemical short-range structure units of Pd_6Ge trigonal prism. (author).

23060 (JAERI-M–93-228, pp. 709-716) **Crystallization of $Fe_{75.8}(Cu,Nb)_{3.5}(Si,B)_{20.7}$ amorphous alloy studied by small angle neutron scattering.** Ohnuma, M. (Muroran Inst. of Tech., Hokkaido (Japan)); Usui, Y.; Hamaguchi, Y.; Suzuki, J.; Funahashi, S. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The crystallization of $Fe_{75.8}(Cu,Nb)_{3.5}(Si,B)_{20.7}$ amorphous alloy has been studied by small angle neutron scattering in magnetic field. The magnetic contribution of the scattering has been distinguished from the nuclear contribution for alloys with various annealing temperatures and time. The existence of magnetic fluctuation has been confirmed even in amorphous state. The peak corresponding to the correlation between crystallized phase has been found in the Q region of 0.2 - 0.3 nm^{-1}. However, over 0.4 nm^{-1} region the scattering function I(Q) decays as Q^{-2} - Q^{-3} which are unexpected functions for precipitates with rigid surface, Q^{-4}. For the alloys of 500degC 60 min and 550degC 60 min the contribution of the nuclear scattering can be observed in the region of Q<0.1 nm^{-1}. (author).

23061 (SLAC-PUB–6466) **A photoemission study of Au, Ge, and O_2 deposition on NH_4F etched Si(111).** Terry, J.; Cao, R.; Wigren, C.; Pianetta, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (SLAC/SSRL–0072; CONF-9311104–22: 40. national symposium of the American Vacuum Society (AVS), Orlando, FL (United States), 15-19 Nov 1993). Order Number DE94013352. Source: OSTI; NTIS; INIS; GPO Dep.

We have studied the interaction of a metal, Au, a semiconductor, Ge, and a non-metal, O_2, with the NH_4F etched Si(111) surface with photoemission spectroscopy. Two components were present in Si 2p core level spectra from the H-terminated surface. We observed the flat band condition from the as-etched, n-type, Si(111) surface. We performed stepwise depositions of Au and measured the band bending with photoemission spectroscopy. The Fermi level pinned near mid-gap as Au was deposited onto the as-etched surface. After the deposition of 1 ML of Au, a Au-silicide layer formed. This interfacial component indicated that the passivating H layer was compromised. As the Au coverage was increased, layers of pure Au formed between the bulk silicon and the Au-silicide layer. The observed behavior was nearly identical to that of Au deposition on the Si(111) 7 x 7 surface. Next, we tested the ability of the monohydride layer to sustain surfactant assisted growth of Ge. Ge islanding was observed at 400°C indicating that good surfactant growth was not obtained. Although the monohydride layer was not a good surfactant for the Si(111) surface at this temperature, further study at different temperatures is needed to determine the ability of the ideal monohydride layer to act as a surfactant. Finally, we observed no oxidation of the as-etched surface at room temperature upon exposure to molecular oxygen.

6653 Interactions Between Beams and Condensed Matter

Refer also to citation(s) 22017, 23040

23062 (BNL–60451) **Resonant x-ray scattering in 5f magnetism.** Lander, G.H. (European Commission, JRC, Inst. for Transuranium Elements, Karlsruhe (Germany)); Stirling, W.G.; Langridge, S.; Gibbs, D. Brookhaven National Lab., Upton, NY (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-940819–1: International conference on magnetism, Warsaw (Poland), 22-26 Aug 1994). Order Number DE94013753. Source: OSTI; NTIS; INIS; GPO Dep.

Large enhancements of the magnetic cross section of photons occurs when the energy is tuned near to an absorption edge. Examples of this effect in the actinides at the M_{IV} edge are presented. The excellent resolution available with x-ray synchrotron beams has allowed new features in both the magnetic structure and the critical regime to be determined. The technique is also sensitive to the near-surface region. Some of the possibilities with the new 3rd-generation synchrotrons will be discussed.

23063 (JAERI-M–93-228, pp. 434-438) **Spin wave excitations in a Kondo material $CeCu_2$.** Kohgi, Masahumi (Tohoku Univ., Sendai (Japan). Dept. of Physics); Osakabe, Toyotaka; Morii, Yukio; Funahashi, Satoru; Onuki, Yoshichika; Yoshizawa, Hideki. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The low lying magnetic excitations in the Kondo lattice $CeCu_2$ were studied at the temperatures below the Neel temperature by means of neutron inelastic scattering. Rather well-defined spin wave excitations were observed below about 1.5 meV along the principal axes in the a*-b* reciprocal lattice plane. The excitation energy is nearly constant along the [ζ,0,0] direction with the energy around 1.4 meV, while it shows a dip down to the energy of about 0.7 meV along the line [ζ,1/2,0]. From the scattering vector dependence of the cross-section of the excitation, it is concluded that the spin fluctuations in the antiferromagnetic phase of $CeCu_2$ are mainly along the a-axis direction. (author).

23064 (JAERI-M–93-228, pp. 563-570) **Phase formation of physically associating polymer blends.** Tanaka, Fumihiko (Tokyo Univ. of Agriculture and Technology, Fuchu (Japan). Faculty of General Education). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Polymers exhibit a variety of condensed phases when some of their segments are capable of forming weak bonds which can be created and destroyed by thermal motion. Transition from one phase to another caused by such 'segment association' is reversible by the change of the temperature and the concentration,

so that it is called 'reversible phase transition'. What types of reversible phase formation are possible for a given associative interaction? What is the most fundamental laws which govern the competition between molecular association and phase separation? This paper surveys, as typical examples of reversible phases, macroscopic phase separation, microphase formation, solvation, gelation, etc. from the unified point of view, and explores the possibility of new condensed phases caused by their mutual interference. (author).

23065 (JAERI-M–93-228, pp. 571-577) **SANS study of polymer chains in confined space.** Hasegawa, Hirokazu (Kyoto Univ. (Japan). Faculty of Engineering); Tanaka, Hideaki; Hashimoto, Takeji; Han, C.C. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

The lateral and vertical components of the radius of gyration for a single block copolymer chain in the lamellar microdomain space formed by a mixture of diblock copolymers and homopolymers were investigated by means of small-angle neutron scattering (SANS), and the microdomain structures by small-angle X-ray scattering (SAXS). We used the homopolymers whose molecular weights are much smaller than that of the corresponding chains of the block copolymers so that the homopolymers are uniformly solubilized in the corresponding microdomains. The SANS result suggests that the block copolymer chains in the microdomain space are more compressed in the direction parallel to the interface and more stretched in the direction perpendicular to the interface than the corresponding unperturbed polymer chains with the same molecular weight. With increasing the volume fraction of the homopolymers the thickness of the lamellar microdomains increases. The block copolymer chains were found to undergo an isochoric affine deformation on addition of the homopolymers or with the change of the thickness of the lamellar microdomains. (author).

23066 (JAERI-M–93-228, pp. 641-646) **Is there any correlation between the intermolecular structures around amin-group metal ion in liquid and crystaline states?.** Ichikawa, K. (Hokkaido Univ., Sapporo (Japan). Faculty of Science); Kameda, Y.; Kotani, S. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

We have determined the environmental structure around a metal ion and the orientational conformation among the complex ions in liquid state, such as the environmental structure around Li^+ in ionic or incompletely hydrated-ionic melts and the intermolecular geometry among NO_3^- ions and $AlCl_4^-$ ions with the aid of time-of-flight neutron diffraction and isotopic substitution techniques. The space and time average local structures in liquid state do not reflect any crystal structure. Because the lattice energy of ionic crystal should be interpreted in terms of the Madelung constant: the energy of ionic melts or incompletely hydrated-ionic melts can be determined by the local configuration around an ion. (author).

23067 (JAERI-M–93-232) **Formation of solid particles from aqueous solutions of palladium sulfate and of palladium sulfate-silver sulfate by gamma ray irradiation.** Hatada, Motoyoshi (Japan Atomic Energy Research Inst., Neyagawa, Osaka (Japan). Osaka Lab. for Radiation Chemistry). Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1993. 49p. Order Number DE94770758. Source: OSTI; NTIS; INIS.

Aqueous solutions containing (a) palladium sulfate (b) palladium sulfate and silver sulfate, and (c) silver sulfate saturated with nitrogen were irradiated with cobalt 60 gamma radiations (dose rate, 2.35 and 11.2 kGy/h; temperature: 10 and 29-45degC). The pH's of the most solutions were 1.43 or 0.43. Formation of fine particles was studied from the decrease of optical absorption of the metal ions, and from mass measurement of solid precipitate. It was found that (1) palladium ion decreased with dose in the solutions (a) and (b) with appearance of continuum spectra from 200-700nm range due to solid particles, and (2) silver ion decreased with increasing dose in solution (b) while it did not decrease in solution (c), and (3) electric conductive precipitate was formed in solution (a) and solution (b), but no precipitate was found in solution (c) by the irradiation. The results indicate that (1) palladium ion was reduced to form metallic precipitate in any condition studied, but (b) silver ion was reduced only in the presence of palladium ion, and (3) bimetallic particles were formed in solution (b). The amounts of the precipitates recovered from the irradiated solutions were 57% for solution (a) and 97% for (b) of the amounts of ions reacted. (author).

23068 (JAERI-M–93-248) **Formation of fine palladium particles from palladium sulfate aqueous solution by gamma-ray irradiation as observed by electronic absorption spectroscopy and dynamic light scattering.** Jonah, C.D. (Argonne National Lab., IL (United States)); Hatada, Motoyoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 38p. Order Number DE94770602. Source: OSTI; NTIS; INIS.

To find a way of probing the coagulation of metal particles formed by the irradiation of metallic ion solution without surfactant, palladium sulfate aqueous solution was irradiated with gamma rays (11.2kGy/h, 10kGy) and turbidity change of the solution after irradiation was followed by optical density at 700nm using a UV-visible spectrophotometer. The particle diameter distribution was monitored by dynamic light scattering. The results indicate that the turbidity decreased monotonously, and that there are major peaks in the distributions, one with diameters in the 400-800nm region and the other with diameters in the 1500-2500nm. The density of the particles seems to be smaller than that of bulk palladium metal. Similar experiments were carried out on palladium-silver sulfate solution. (author).

23069 (KEK-PROC–93-8, pp. 193-199) **Metallic colloid formation in anionic crystal by high energy radiation.** Owaki, S. (Osaka Univ., Ibaraki (Japan). Inst. of Scientific and Industrial Research); Koyama, S.; Nobugai, K.; Okada, T.; Inabe, K.; Fukuda, Y. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jun 1993. (CONF-9301135–: 7. workshop on radiation detectors and their uses, Tsukuba (Japan), 26-27 Jan 1993). In *Radiation detectors and their uses.* 236p. Order Number DE94737963. Source: OSTI; NTIS; INIS.

Several studies have shown that metallic colloids (clusters) are formed in some ionic crystals. The crystals, irradiated by ionizing radiation contain dense defects such as F centers, F_2 centers, and so on. At higher temperature, these defects have a chance to aggregate and grow to be metallic colloids. High energy radiation is known to be a convenient method for providing this condition. In this study, electron pulses of high-peak current and high-energy from an accelerator have proved to form the colloids successfully in NaCl single crystals. Existence of the colloids was observed by the usual methods of optical absorption and electron microscopy. The physical state of the colloids is discussed on the basis of experimental results of positron annihilation lifetime and X-ray photoelectron spectroscopy in crystals containing the colloids. (J.P.N.).

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Refer also to citation(s) 21934

23070 (DOE/ER/45416–4) **Synchrotron studies of narrow band materials: Progress report, July 1, 1993–June 30, 1994.** Michigan Univ., Ann Arbor, MI (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45416. Order Number DE94013698. Source: OSTI; NTIS; GPO Dep.

This progress report is divided into: activity (beamtime, data analysis, lab studies); model Fermi liquids and non-Fermi liquids ($TiTe_2$-further ARPES and lineshape analysis, TiS_2 ARPES, $K_{0.3}MoO_3$ and $Li_{0.9}Mo_6O_{17}$ ARPES); insulator to metal transitions (early transition metal oxides, Fe_3O_4, $La_{2-x}Sr_xCuO_4$ ARPES); rare earth and actinide materials ($U(Cu_{1-x}Pd_x)_5$, $U(Pt_{1-x}Pd_x)_3$, $CeAl_3$

and $CeSi_2$ resonant photoemission, $CeFe_2/CeRh_3B_2/CeCo_2/CeCo_5$ x-ray magnetic circular dichroism); and technique oriented resonant photoemission studies (resonant ARPES in $TiTe_2$, resonant photoemission at 2p edge in $TiTe_2$).

23071 (LA-UR-94-1164) **Consequences of competing hybridization for magnetic ordering in correlated-electron lattices.** Sanchez-Castro, C. (West Virginia Univ., Morgantown, WV (United States). Dept. of Physics); Cooper, B.R.; Bedell, K.S. Los Alamos National Lab., NM (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940629–5: 6. joint conference on magnetism and magnetic materials, Albuquerque, NM (United States), 20-23 Jun 1994). Order Number DE94011648. Source: OSTI; NTIS; GPO Dep.

We present a method for calculating the f – f ion interaction in systems where a transition metal species also hybridizes with the same Fermi sea. For the physical systems of interest, typically species f is a light rare earth (e.g. Ce or Pr) or a light actinide (U) involving a partially filled f-shell and species d is a d-shell transition metal ion; and there may be experimental evidence of competition between magnetic ordering of the f and d electron systems (e.g. when f is U and d is Mn). The method treats first the strong hybridization between the d and the conduction electrons to obtain a new ground state with delocalized d electrons. Then it calculates the f – f ion interaction by perturbation theory. We identify the mechanisms by which the d electrons modify the f – f ion interaction.

23072 (PPPL–2992) **Numerical studies on soliton propagation in the dielectric media by the nonlinear Lorentz computational model.** Abe, H.; Okuda, H. Princeton Univ., NJ (United States). Plasma Physics Lab. Jun 1994. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94013103. Source: OSTI; NTIS; INIS; GPO Dep.

Soliton propagation in the dielectric media has been simulated by using the nonlinear Lorentz computational model, which was recently developed to study the propagation of electromagnetic waves in a linear and a nonlinear dielectric. The model is constructed by combining a microscopic model used in the semi-classical approximation for dielectric media and the particle model developed for the plasma simulations. The carrier wave frequency is retained in the simulation so that not only the envelope of the soliton but also its phase can be followed in time. It is shown that the model may be useful for studying pulse propagation in the dielectric media.

665410 Superconductivity

Refer also to citation(s) 21866, 22003, 22279

23073 (ANL/MCS/CP–83249) **New techniques for parallel simulation of high-temperature superconductors.** Freitag, L. (Argonne National Lab., IL (United States)); Plassmann, P.; Jones, M. Argonne National Lab., IL (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9405100–7: Scalable high performance computing conference, Knoxville, TN (United States), 23 May 1994). Order Number DE94013875. Source: OSTI; NTIS; GPO Dep.

In this paper we discuss several new techniques used for the simulation of high-temperature superconductors on parallel computers. We introduce an innovative methodology to study the effects of temperature fluctuations on the vortex lattice configuration of these materials. We have found that the use of uniform orthogonal meshes results in several limitations. To address these limitations, we consider nonorthogonal meshes and describe a new discrete formulation that solves the difficult problem of maintaining gauge invariance on nonorthogonal meshes. With this discretization, adaptive refinement strategies are used to concentrate grid points where error contributions are large (in this case, near vortex cores). We describe the algorithm used for the parallel implementation of this refinement strategy, and we present computational results obtained on the Intel DELTA.

23074 (BNL–60297) **Dynamical impurity problems.** Emery, V.J. (Brookhaven National Lab., Upton, NY (United States)); Kivelson, S.A. Brookhaven National Lab., Upton, NY (United States). [1993]. 26p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. Grant DMR-93-12606. (CONF-9306338–1: 1993 international summer school on fundamental problems in statistical mechanics, Altenberg (Germany), 27 Jun - 10 jul 1993). Order Number DE94013025. Source: OSTI; NTIS; INIS; GPO Dep.

In the past few years there has been a resurgence of interest in dynamical impurity problems, as a result of developments in the theory of correlated electron systems. The general dynamical impurity problem is a set of conduction electrons interacting with an impurity which has internal degrees of freedom. The simplest and earliest example, the Kondo problem, has attracted interest since the mid-sixties not only because of its physical importance but also as an example of a model displaying logarithmic divergences order by order in perturbation theory. It provided one of the earliest applications of the renormalization group method, which is designed to deal with just such a situation. As we shall see, the antiferromagnetic Kondo model is controlled by a strong-coupling fixed point, and the essence of the renormalization group solution is to carry out the global renormalization numerically starting from the original (weak-coupling) Hamiltonian. In these lectures, we shall describe an alternative route in which we identify an exactly solvable model which renormalizes to the same fixed point as the original dynamical impurity problem. This approach is akin to determining the critical behavior at a second order phase transition point by solving any model in a given universality class.

23075 (CONF-931009–26) **Progress in the development of the silver-addition process for preparing textured "1223" Tl-Ca-Ba-Cu-oxide thick films.** DeLuca, J.A. (General Electric Corp., Schenectady, NY (United States). Research and Development Center); Karas, P.L.; Briant, C.L.; Tkaczyk, J.E.; Goyal, A. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Fall meeting of the Minerals, Metals and Materials Society: physical metallurgy and materials; Pittsburgh, PA (United States); 17-21 Oct 1993. Order Number DE94012333. Source: OSTI; NTIS; GPO Dep.

Progress in key areas is reported for the continued development of the silver-addition process for preparing textured "1223" Tl-Ca-Ba-Cu-oxide thick films; film homogeneity, film growth mechanism, scale-up, and flexible substrates. As a consequence of refinements in the precursor oxide film preparation and the development of a "flow" reactor, superconducting films on polycrystalline YSZ have been prepared that exhibit zero-field J_c values (77K) as high,as 366,000 A/cm^2. Advantage has been taken of these process improvements to prepare a textured "1223" thick film with T_c=109K on a zirconia coated metal substrate. When placed in a magnetic field there is an initial drop in J_c, attributed to the presence of weak links. However, after this initial drop, the film exhibits the characteristic behavior expected of strongly linked "1223." The film growth mechanism underlying the silver-addition process is discussed in light of the results-of microstructural studies of samples quenched at different times into the thallination process.

23076 (CONF-9404139–1) **Spin-polarons and high-$T_c$superconductivity.** Wood, R.F. Oak Ridge National Lab., TN (United States). Mar 1994. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Workshop on polarons and bipolarons in high Tc superconductors; Cambridge, MA (United States); 7-9 Apr 1994. Order Number DE94013273. Source: OSTI; NTIS; INIS; GPO Dep.

The spin-polaron concept is introduced in analogy to ionic and electronic polarons and the assumptions underlying the author's approach to spin-polaron mediated high-$T_c$superconductivity are discussed. Elementary considerations about the spin-polaron formation energy are reviewed and the possible origin of the pairing mechanism illustrated schematically. The electronic structure of the CuO_2 planes is treated from the standpoint of antiferromagnetic band calculations that lead directly to the picture of holes predominantly on the oxygen sublattice in a Mott-Hubbard/charge transfer

insulator. Assuming the holes to be described in a Bloch representation but with the effective mass renormalized by spin-polaron formation, equations for the superconducting gap, Δ, and transition temperature, T_c, are developed and the symmetry of Δ discussed. After further simplifications, T_c is calculated as a function of the carrier concentration, x. It is shown that the calculated behavior of $T_c(x)$ follows the experimental results closely and leads to a natural explanation of the effects of under- and over-doping. The paper concludes with a few remarks about the evidence for the carriers being fermions (polarons) or bosons (bipolarons).

23077 (DOE/SR/18273–2) **Applications of high transition temperature superconductors at the Savannah River Site: Annual progress report.** Payne, J.E.; Payne, L.L. South Carolina State Univ., Orangeburg, SC (United States). Dept. of Natural Sciences. Apr 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-92SR18273. Order Number DE94012938. Source: OSTI; NTIS; GPO Dep.

The second year of the research program has involved further evaluation of the applications of high transition temperature superconducting devices at the Savannah River Site and the fabrication of magnetic shields from high T_c materials that might be of use in programs at the site. In cooperation with AVX Corporation, a satisfactory magnetic shield has been developed and the results of tests on it are included in this report. In addition, results have been reported by undergraduate students. The improved version of a nitrogen temperature SQUID for applications such as those that might be encountered at the site has suffered setbacks in development. It has been possible to begin the initial studies with a high T_c device but some of the more detailed analysis has been restricted. The new device was received this month and will have an important impact on the outcome of the project by allowing for a more complete evaluation of a device that can be used in an industrial situation.

23078 (INIS-mf–13808, pp. 113) **Calculation of band structure of the flux-line lattice in Type II semiconductors.** Poettinger, B. (Inst. fuer Theoretische Physik, Univ. Linz, Linz (Austria)); Klein, U. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TYPE-II SUPERCONDUCTORS/flux quantization; BAND THEORY; ENERGY LEVELS

23079 (INIS-mf–13808, pp. 117) **Brillouin-zone border excitations in high-tc superconductors.** Knoll, P. (Inst. fuer Experimentalphysik, Univ. Graz, Graz (Austria)); Hohenester, U.; Lo, S. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HIGH-TC SUPERCONDUCTORS/magnons; MAGNONS

23080 (IS-M–780) **Critical-state flux-density profiles in type-II superconducting thin-film strips and disks.** Clem, J.R. Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Physics and Astronomy. [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-940122–4: 7. IWCC international workshop on critical currents in superconductors, Alpbach (Austria), 24-27 Jan 1994). Order Number DE94011199. Source: OSTI; NTIS; GPO Dep.

When a weak magnetic field is applied to a superconducting strip or disk of thickness d (of the order of the penetration depth λ) much less than its width or radius, induced super-currents flow so as to prevent magnetic flux from penetrating the superconductor (except within λ of the edge). A stronger field causes vortices to enter, and the profiles of the macroscopic flux density B are determined by critical-state equations describing bulk pinning. Near the sample edge, where the vortices are, the magnitude of the current density J is J_c. In vortex-free regions of the sample, the magnitude of J is less than J_c but is not zero. The profiles of B can be calculated analytically by assuming that J, averaged over the film thickness, is given by the difference between the values of the tangential component of B at the top and bottom surfaces of the film. This paper examines the basis for this assumption, which is equivalent to assuming that the current density is determined solely by the curvature of H, rather than by the gradient of its magnitude. It is shown that this is a good approximation for thin-film strips and disks.

23081 (LA-UR–94-1418) **Flux creep: Its dependence on current denisty and relation to critical current densities from transport and magnetic measurements.** Maley, M.P.; Kung, P.J.; Cho, J.H.; Willis, J.O. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940651–2: International workshop on superconductivity: critical current of high-temperature superconductors and related topics, Kyoto (Japan), 6-9 Jun 1994). Order Number DE94011701. Source: OSTI; NTIS; GPO Dep.

Thermally activated flux motion dominates the transport properties of HTS conductors over a large portion of the H-T phase diagram. The activation energy for this flux motion is generally a non-linear function, U(J), of the current density. We discuss methods and results of U(J) determination for HTS materials and implications for the critical current densities inferred from magnetic hysteresis measurements.

665430 Other Topics in Quantum Fluids and Solids

23082 (JAERI-M–93-228, pp. 541-546) **Spinodal decomposition in fluid mixtures.** Kawasaki, Kyozi (Kyushu Univ., Fukuoka (Japan). Dept. of Physics); Koga, Tsuyoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

We study the late stage dynamics of spinodal decomposition in binary fluids by the computer simulation of the time-dependent Ginzburg-Landau equation. We obtain a temporary linear growth law of the characteristic length of domains in the late stage. This growth law has been observed in many real experiments of binary fluids and indicates that the domain growth proceeds by the flow caused by the surface tension of interfaces. We also find that the dynamical scaling law is satisfied in this hydrodynamic domain growth region. By comparing the scaling functions for fluids with that for the case without hydrodynamic effects, we find that the scaling functions for the two systems are different. (author).

6655 Direct Energy Conversion

23083 (ENEA-RT-NUCL–92-32) **Evolution of multi-mode Rayleigh-Taylor instability towards self-similar turbulent mixing.** Atzeni, S. (ENEA, Frascati (Italy). Area Nucleare); Guerrieri, A. Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy). Dec 1992. 12p. (RT/NUCL–92-32). Order Number DE94775313. Source: OSTI; NTIS (US Sales Only).

The evolution of the multimode Rayleigh-Taylor instability of nearly incompressible fluids, with density ratio r = 2, is investigated by means of two-dimensional hydrodynamic simulations. The study focuses on the effect of the initial perturbation on the evolution towards turbulent mixing. It is shown that, for sufficiently large times, a self-similar mixing regime occurs, in which typical spatial scales (such as the size of the mixed layer) evolve proportionally to $g(t-t_0)^2$, where g is the gravity, t the time, and t_0 is a characteristic time depending on the initial conditions. A model for the prediction of t_0 is then presented, which is in agreement with the simulations.

23084 (KFK–5247) **Fully developed magnetohydrodynamic flows in rectangular ducts with insulating walls.** Molokov, S. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Angewandte Thermo- und Fluiddynamik (IATF)); Shishko, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Angewandte Thermo- und Fluiddynamik (IATF);

Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Oct 1993. 61p. Order Number DE94773926. Source: OSTI; NTIS (US Sales Only); INIS.

In the first part the effect of magnetic field inclination on the flow structure and the pressure drop is considered. The duct walls are insulating. An asymptotic solution to the problem at high Hartmann numbers is obtained. The results show that for a square duct the increase of the pressure gradient due to the field inclination is negligible (less than 10% for any angle). For blanket relevant values of inclination of up to 10 the deviation of the velocity profile from the slug profile is insignificant. The second part studies the flow in a duct with insulating walls parallel to the magnetic field, while the Hartmann walls are covered by an insulating coating. A new type of the boundary condition is derived, which takes into account finite coating resistance. The effect of the latter on the flow characteristics is studied. An exact solution to the problem is obtained and several approximate formulas for the pressure drop at high Hartmann numbers are presented. (orig./HP)

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Refer also to citation(s) 21715, 22753

7003 Plasma Physics and Fusion Research

Refer also to citation(s) 22272, 22277, 23003, 23082, 23178, 23189, 23197, 23200, 23210, 23212, 23214, 23215, 23216, 23217, 23218, 23219, 23220, 23221, 23222, 23231, 23233, 23247, 23248, 23250, 23253

23085 (CNIC–00732) **Simplified ideal MHD normal mode equations for toroidal axisymmetric plasmas.** Shi Bingren (Southwest Inst. of Physics, Leshan, SC (China)). China Nuclear Information Centre, Beijing, BJ (China). Mar 1993. 12p. (SIP–0058.). Order Number DE94627004. Source: OSTI; NTIS (US Sales Only); INIS.

The ideal MHD normal mode equations for general toroidal axisymmetric plasmas can be significantly simplified by properly treating the compressibility term in two limiting cases. The simplified equations, describing the general global modes (the low n, m mode), contain only two scalar functions. For tokamak plasmas, a further simplification, the shear Alfven approximation, is introduced, it makes possible to describe the global mode by a simplified eigenmode equation with only one scalar function. This eigenequation, similar to the reduced tokamak equations widely used in recent literatures, provides and unified way to analyze the kink, Alfven spectrum and MHD TAE (toroidal Alfven eigenmode) modes.

23086 (CNIC–000738) **Numerical solution of second-order wave equation.** Jian Guangde (Southwest Inst. of Physics, Leshan, SC (China)); Huang Lin. China Nuclear Information Centre, Beijing, BJ (China). Apr 1993. 10p. (In Chinese). (SIP–0060.). Order Number DE94626987. Source: OSTI; NTIS (US Sales Only); INIS.

A second-order differential equation of mode conversion of fast wave for fusion plasma is solved by a single step routine with automatic step varying. On the obtained results, the total power absorption and the reflection coefficient are calculated. In order to reduce the computational time, the plasma dispersion function $Z(\xi)$ is calculated section by section. The results are in good agreement with theoretical analysis.

23087 (CNIC–00757) **The experimental investigation of plasma configuration in MM-4U device.** Ming Linzhou (Southwest Inst. of Physics, Leshan, SC (China)); Wu Guanjun; Li Zhicai; Ye Rubin; Wang Jihai; Zhao Guoping; Xu Liyun. China Nuclear Information Centre, Beijing, BJ (China). May 1993. 7p. (In Chinese). (SIP–0062.). Order Number DE94626964. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental results of axial magnetic field profiles in some mirror ratios are given. The experimental results are in good agreement with the theoretical calculations. The axial plasma potential profiles in four mirror ratios have been measured. It shows that the tandem mirror confinement configuration of barrier-like axisymmetric negative potential can be established in various mirror ratios and the central cell plasma potential absolute value increases with the decreasing of mirror ratio. The measured plasma density profile is similar to that of the potential. The typical values of plasma parameter are as follows: The plasma potential in eastern and western end cells and in the central cell are -126 V, -105 V and -50 V, respectively. The corresponding electron densities are 4×10^{10} cm^{-3}, 3.6×10^{10} cm^{-3} and 2.0×10^{10} cm^{-3} and the electro temperature is 43 eV. The measured electron temperature is proportional to the injected electron energy. When the injected electron energy is increased, the plasma potential is dropping and the electron density is increasing. The electron density is proportional to the square magnetic field. The discussion of the above results is also presented.

23088 (CONF-930720–24) **ICRF heating of TFTR deuterium supershot plasmas in the ^{3}He minority regime.** Taylor, G. (Princeton Plasma Physics Lab., NJ (United States)); Wilson, J.R.; Goldfinger, R.C. Oak Ridge National Lab., TN (United States). [1993]. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 20. European conference on controlled fusion and plasma physics; Lisbon (Portugal); 26-30 Jul 1993. Order Number DE94013280. Source: OSTI; NTIS; INIS; GPO Dep.

The increased core electron temperature produced by ICRF heating of TFTR, D-T neutral-beam-heated supershot plasmas is expected to extend the alpha particle slowing down time and hence enhance the central alpha particle pressure. In preparation for the TFTR D-T operational phase, which is due to start in late 1993, a series of experiments were conducted on TFTR to explore the effect of ICRF heating on the performance and stability of low recycling, deuterium supershot plasmas in the ^{3}He minority heating regime. The coupling of up to 7.4 MW of 47 MHz ICRF power to full size, ^{3}He minority, deuterium supershots heated with up to 30 MW of deuterium neutral beam injection has resulted in a significant increase in core electron temperature. Simulations of equivalent D-T supershots predict that such ICRF heating should result in approximately a 60% increase in the alpha particle slowing down time and an enhancement of about 30% in the central alpha pressure. Future experiments to be conducted at ICRF powers up to 12.5 MW during the upcoming TFTR D-T campaign may result in even greater enhancements in core alpha parameters. This paper presents results from experiments performed at an axial toroidal magnetic field of ~4.8T, where the minority resonance was within 0.1–0.15 m of the plasma core. Combined ICRF and neutral beam heating powers in these experiments reached TFTR record levels of over 37 MW, which allowed an exploration of the power loading limits on the carbon limiter tiles. The plasma current was operated at 1.85 and 2.2 MA and sawtooth suppression was observed at the higher plasma current.

23089 (CONF-9311147–8) **L-H transition in tokamaks and stellarators.** Shaing, K.C. (Oak Ridge National Lab., TN (United States)); Hsu, C.T.; Christenson, P.J. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From IAEA meeting on H-mode physics; Naka (Japan); 15-17 Nov 1993. Order Number DE94013257. Source: OSTI; NTIS; INIS; GPO Dep.

It is shown that the bifurcation dynamics in the H-mode theory based on the ion orbit loss and nonlinear viscosity is not sensitive to the radial pressure and temperature gradients after bifurcation. This allows the poloidal flow velocity to be opposite to that of the poloidal E x B velocity in the H-mode phase if the pressure gradient is steep. Here, E(B) is the electric (magnetic) field. The theory is also extended to stellarator configurations to demonstrate that the tokamak H-mode theory can be tested in a controlled manner in those devices. A set of poloidal and toroidal momentum evolution equations is derived in which the radial current density outside the last closed flux surface is expressed in terms of the radial integral of the poloidal current density into the diverter plates. This facilitates the calculation of the radial electric field profile across the separatrix.

23090 (DOE/ER/53198–238) **A fast spectroscopic diagnostic for the measurement of plasma impurity ion dynamics.** Den Hartog, D.J.; Fonck, R.J. Wisconsin Univ., Madison, WI (United States). Apr 1994. 15p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract FG02-85ER53198. Order Number DE94012985. Source: OSTI; NTIS; INIS; GPO Dep.

A high-resolution spectrometer has been developed and used to measure simultaneously impurity ion temperature and flow velocities in high temperature plasmas with 10 μs temporal resolution (limited by digitization rate). This device is actually a duo-spectrometer: measurements from two different chordal views of the plasma can be made simultaneously via two separate quartz input fiber optic bundles coupled to the entrance slits which are tilted to compensate for line curvature. The dispersed spectra on the exit plane of the duo-spectrometer are coupled via quartz fiber optics to two arrays of 16 photomultiplier tubes each. Measurement made by recording the Doppler broadened and shifted 227.091 nm emission from the CV impurity ions in the MST reversed-field pinch (RFP) plasma have achieved precisions of <6 eV for temperatures of 150 Ev and <0.7 km/s for flow velocities of 6 km/s. Representative results from the MsT RFP indicate that the toroidal flow velocity drops and ion temperature increases during saw tooth events in MST.

23091 (DOE/ER/53198–239) **Fast electron generation and transport in a turbulent, magnetized plasma.** Stoneking, W.R. Wisconsin Univ., Madison, WI (United States). May 1994. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53198. Order Number DE94012986. Source: OSTI; NTIS; INIS; GPO Dep.

The nature of fast electron generation and transport in the Madison Symmetric Torus (MST) reversed field pinch (RFP) is investigated using two electron energy analyzer (EEA) probes and a thermocouple calorimeter. The parallel velocity distribution of the fast electron population is well fit by a drifted Maxwellian distribution with temperature of about 100 eV and drift velocity of about 2 $\times$ 10^6 m/s. Cross-calibration of the EEA with the calorimeter provides a measurement of the fast electron perpendicular temperature of 30 eV, much lower than the parallel temperature, and is evidence that the kinetic dynamo mechanism (KDT) is not operative in MST. The fast electron current is found to match to the parallel current at the edge, and the fast electron density is about 4 $\times$ 10^{11} cm^{-3} independent of the ratio of the applied toroidal electric field to the critical electric field for runaways. First time measurements of magnetic fluctuation induced particle transport are reported. By correlating electron current fluctuations with radial magnetic fluctuations the transported flux of electrons is found to be negligible outside r/a$\sim$0.9, but rises the level of the expected total particle losses inside r/a$\sim$0.85. A comparison of the measured diffusion coefficient is made with the ausilinear stochastic diffusion coefficient. Evidence exists that the reduction of the transport is due to the presence of a radial ambipolar electric field of magnitude 500 V/m, that acts to equilibrate the ion and electron transport rates. The convective energy transport associated with the measured particle transport is large enough to account for the observed magnetic fluctuation induced energy transport in MST.

23092 (DOE/ET/53088–654) **Isotope scaling and η_i mode with impurities in tokamak plasmas.** Dong, J.Q.; Horton, W.; Dorland, W.D. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Apr 1994. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088. (IFSR–654). Order Number DE94012763. Source: OSTI; NTIS; INIS; GPO Dep.

The ion temperature gradient driven instability, or η_i mode, is studied for discharges with hydrogen, deuterium or tritium in a toroidal magnetic configuration. Impurity effects on the mode and the instability which is driven by the presence of impurity ions (impurity modes) are studied as well. It is found that the maximum growth rate of the η_i mode scales as $M^{\frac{-1}{2}}$ for pure hydrogen, deuterium or tritium discharges, where M is the mass of the working gas ion. With the inclusion of impurity ions the growth rates of η_i mode decrease in all three kinds of plasmas with a hydrogen plasma still having the highest maximum growth rate, tritium the lowest, and deuterium in between. However, the isotope effects are weaker and scale as $M_{eff}^{\frac{-1}{2}}$ with the presence of impurity ions, where the effective mass M_{eff} is a combination of A_i and A_z, the mass number of hydrogenic and impurity ions. For the impurity mode the situation is similar to that of the η_i mode without impurity ions. Experimental database shows that the plasma energy confinement time scales as $\tau_E \sim A_i^{\frac{1}{2}}$ in clean plasmas. The correlation of the theoretical results with the experimental confinement scaling is discussed.

23093 (DOE/ET/53088–657) **Momentum-energy transport from turbulence driven by parallel flow shear.** Dong, J.Q. (Univ. of Texas, Austin, TX (United States)); Horton, W.; Bengtson, R.D.; Li, G.X. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Apr 1994. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088 ; FG05-88ER53266. (IFSR–657). Order Number DE94012765. Source: OSTI; NTIS; INIS; GPO Dep.

The low frequency E $\times$ B turbulence driven by the shear in the mass flow velocity parallel to the magnetic field is studied using the fluid theory in a slab configuration with magnetic shear. Ion temperature gradient effects are taken into account. The eigenfunctions of the linear instability are asymmetric about the mode rational surfaces. Quasilinear Reynolds stress induced by such asymmetric fluctuations produces momentum and energy transport across the magnetic field. Analytic formulas for the parallel and perpendicular Reynolds stress, viscosity and energy transport coefficients are given. Experimental observations of the parallel and poloidal plasma flows on TEXT-U are presented and compared with the theoretical models.

23094 (DOE/ET/53088–658) **MARFEs in tokamak edge plasma: Pattern formation under nonlocal constraints.** Meerson, B. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Petviashvili, N.; Tajima, T. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Apr 1994. 14p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract FG05-80ET53088. (IFSR–658). Order Number DE94012766. Source: OSTI; NTIS; INIS; GPO Dep.

A simplified two-dimensional nonlinear fluid model is developed to elucidate the basic mechanism of the formation of multifaceted asymmetric radiation from the edge of tokamak plasmas (MARFE). In the framework of a mixed Eulerian-Lagrangian description, the problem is reduced to reaction-diffusion-type equation with nonlocality, which obeys the constraints of length constancy and mass conservation along the magnetic field. With a simple cooling function, this model predicts formation of stationary MARFE-like structures.

23095 (ENEA-RT-NUCL–92-33) **Relation between normalized thermal energy and safety factor for tokamaks.** Segre, S.E. (Rome Univ. II (Italy). Dipt. di Fisica); Zanza, V. Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy). Dec 1992. 11p. (RT/NUCL–92-33). Order Number DE94775228. Source: OSTI; NTIS (US Sales Only).

It is shown that, within the framework of the extended neoclassical theory, for a tokamak there exists a relationship between the normalized thermal energy content, Beta, and the normalized plasma current, 1/q. This relationship, which depends essentially only on plasma fueling, is a generalization of the usual Bennett relation and it is of importance for tokamak confinement and heating.

23096 (ENEA-RT-NUCL–92-40) **Density limit in FTU during '90-'91 operation.** Frigione, D. (ENEA, Frascati (Italy). Dipt. Fusione); Pieroni, L. Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy). May 1993. 19p. (RT/NUCL–92-40). Order Number DE94775301. Source: OSTI; NTIS (US Sales Only).

The FTU (Frascati Tokamak Upgrade) (R = 0.93 m; a = 0.3 m; B_T = 8 T; I_p < = 1.6 MA) has operated essentially in the Ohmic regime with both H_2, D_2 and He filling gases. Most of the H_2 and D_2 data, if plotted in the traditional Hugill plot, show an almost q-independent density limit, corresponding to nR/B = 2.3 x 10^{19} Wb^{-1}. This reproduces the FT density limit at q = 6. 7 while it is a factor of 2 lower at q = 3.3. At the latter q value, the FT limit has been fully recovered in He. Peaked density profile discharges reach a higher nRq/B parameter thus supporting the idea that the limiting density is that of the edge. It is found that the operational limit can be expressed by n (at -18 cm) = $(P_{OH})^{1/2}$, as one would expect from a balance between Ohmic input and edge radiated power.

23097 (ETDE/IT-mf–94775345) **Radial particle flow, electrical conductivity and thermal energy content in Frascati Tokamak Upgrade.** Bracco, G. (Associazione EURATOM-ENEA sulla Fusione, Frascati (Italy)); Segre, S.E.; Zanza, V.; Apruzzese, G.; Bombarda, F.; Buratti, P.; Crisanti, F.; De Angelis, R.; Frigione, D.; Gabellieri, L. No corporate text available. 1993. 27p. Order Number DE94775345. Source: OSTI; NTIS (US Sales Only).

The experimental determinations of the radial plasma flow velocity, of Z_{eff} and of the thermal energy content, made on the Frascati Tokamak Upgrade (FTU), were compared with the predictions of the conventional neoclassical theory, of the extended neoclassical theory and of the pseudoneoclassical theory. In the comparison, only the momentum balance and continuity equations were used. The best overall agreement was found for the second of these theories, thus confirming the result of previous analyses.

23098 (GA-A–21603) **Recent DIII-D high power heating and current drive experiments.** Simonen, T.C. (General Atomics, San Diego, CA (United States)); Jackson, G.L.; Mahdavi, M.A.; Petrie, T.W.; Politzer, P.A.; Taylor, T.S.; Lazarus, E.A. General Atomics, San Diego, CA (United States). Feb 1994. 27p. Sponsored by US-DOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ; W-7405-ENG-48 ; AC05-84OR21400 ; FC03-86ER52126. (CONF-931178–2: 5. international Toki conference on plasma physics and controlled nuclear fusion: physics and technology of plasma heating and current drive, Toki (Japan), 16-19 Nov 1993). Order Number DE94012509. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes recent DIII-D high power heating and current drive experiments. Describes are experiments with improved wall conditioning, divertor particle pumping, radiative divertor experiments, studies of plasma shape and high poloidal beta.

23099 (INIS-BR–3305) **Nuclear fusion experimental study on $^{16}O + {}^{60}Ni$ system.** Silva, C.P. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1990. 143p. (In Portuguese). Order Number DE94626997. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear fusion cross section measurements were performed in the energy range near The Coulomb Barrier (E_{Lab} -> 40-72 MeV), for the system $^{16}O + {}^{60}Ni$, aiming the study of Fusion Process involving heavy ions. (L.C.J.A.).

23100 (INIS-BR–3335) **Electronic cyclotron radiation amplification in thermonuclear plasmas.** Ziebell, L.F. Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Inst. de Fisica. 1983. 115p. (In Portuguese). Order Number DE94626967. Source: OSTI; NTIS (US Sales Only); INIS.

The amplified emission of electron cyclotron radiation near the fundamental frequency from an inhomogeneous, anisotropic plasma slab is investigated in a linear theory. Plasma polarization effects are consistently included. Expressions are developed in the WKB approximation for emission in the ordinary and the extraordinary modes, for propagation perpendicular to the magnetic field. Numerical results are given for the extraordinary mode, for which effects are strongest. For the case of a loss-cone-type electron momentum distribution, it is shown that the amplification is sensitively dependent on the ratio of parallel-to-perpendicular temperature and on inhomogeneities in the magnetic field. The dependence of the amplification on the distribution is further investigated by considering superpositions of loss-cone and Maxwellian components. It is show that the presence of a Maxwellian component in general reduces the emission relative to the pure loss-cone case, and situations occur in which a layer in the slab very effectively absorbs all the radiation amplified elsewhere. A peculiar behaviour of the refractive index, which occurs in the transition from the pure loss-cone to the pure Maxwellian case, is discussed. (author).

23101 (INIS-mf–13808, pp. 42) **Precision measurement of the nuclear muon capture rate in ^3He.** Prymas, W. (Inst. fuer Mittelenergiephysik, Oesterreichsche Akademie der Wissenschaften, Boltzmanngasse 3, 1090 Wien, Vienna (Austria)); Balin, D.V.; Baturin, V.M. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HELIUM 3 TARGET/muon reactions; MUON REACTIONS/capture; CAPTURE; MUON-CATALYZED FUSION; REACTION KINETICS

23102 (INIS-mf–13808, pp. 58) **Comparison of transport calculations and -measurements on a neutral-beam-heated plasma.** Woloch, F. (Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria)); Kamelander, G. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. PLASMA/charged-particle transport; ASDEX TOKAMAK; BEAM INJECTION HEATING; DENSITY; ION TEMPERATURE; MATHEMATICAL MODELS; PLASMA; SPATIAL DISTRIBUTION; THERMAL CONDUCTIVITY

23103 (INIS-mf–13808, pp. 154) **Numerical simulation of parametric instabilities.** Kamelander, G. (Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria)); Demchenko, V. Oesterreichische Physikalische Gesellschaft, Vienna (Austria). 1993. 206p. (In German). (CONF-9309381–: 43. annual convention of the Austrian Physical Society, Graz (Austria), 20-24 Sep 1993). In *43. annual convention of the Austrian Physical Society at the Technical University, Graz (Austria), 20-24 September 1993.* Order Number DE94625809. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. LASER RADIATION/parametric instabilities; CURRENT-DRIVE HEATING; PLASMA WAVES

23104 (IPP–III/186(v.1)) **Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.** Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The theory of electron cyclotron resonance phenomena is highly developed. The main theoretical tools are well established, generally accepted and able to give a satisfactory description of the main results obtained in electron cyclotron emission, absorption and current drive experiments. In this workshop some advanced theoretical and numerical tools have been presented (e.g., 3-D Fokker-Planck codes, treatment of the r.f. beam as a whole, description of nonlinear and finite-beam effects) together with the proposal for new scenarios for ECE and ECA measurements (e.g., for diagnosing suprathermal populations and their radial transport). (orig.)

23105 (IPP–III/186(v.1), pp. 19-44) **Theoretical aspects of electron cyclotron emission, heating and current drive.** Gasparino, U. (Max-Planck-Inst. fuer Plasmaphysik, Association EURATOM-IPP, Garching (Germany)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The paper consists of two rather independent parts. The first part is experimentally oriented and refers to the use of emission and absorption as a diagnostic tool for the investigation of a suprathermal electron component adding to the Maxwellian bulk. With this aim, advantages and disadvantages of the presently preferred scenarios (electron cyclotron emission and transmission experiments) are introduced and analyzed. The second part of the paper is more theoretical and refers to the kinetic description of the wave absorption. The induced toroidal current as well as the changes in the neoclassical transport coefficients (r.f. driven radial diffusion and bootstrap current) are discussed. (orig.)

23106 (IPP–III/186(v.1), pp. 45-52) **Relativistic Fokker-Planck equation for cyclotron radiation.** Bornatici, M. (Physics

Dept., Ferrara Univ. (Italy)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

A relativistic Fokker-Planck equation for electromagnetic radiation at the electron cyclotron frequency and harmonics thereof is obtained by means of the electron heat balance equation, with both electron cyclotron absorption (ECA) and emission (ECE) accounted for. With the wave frequency and the solid angle around the direction of the electromagnetic energy flux as the independent variables, the Fokker-Planck integral term is expressed in terms of the specific intensity of radiation, that is the power crossing unit area per unit solid angle and unit frequency range, and the cyclotron emissivity, which is the power radiated (by an individual charge) per unit frequency and per unit solid angle. The steady-state solution of the Fokker-Planck equation is obtained for the specific case of the black-body radiation in the Rayleigh-Jeans limit. (orig.)

23107 (IPP–III/186(v.1), pp. 53-59) **Nonlinear dynamics of electrons interacting with an electron cyclotron wave.** Pozzoli, R. (Dipt. di Fisica, Universita degli Studi, Milan (Italy)); Farina, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

We present here the analysis of the nonlinear adiabatic scattering process, based on the description of the adiabatic motion via the constancy of the Hamiltonian and the invariance of the action integral. The ponderomotive force acting on the electrons is computed and compared with the results of the linear approach. It is found that trapping by the wave strongly modifies the reflection process. (orig.)

23108 (IPP–III/186(v.1), pp. 61-70) **Propagation of electron cyclotron waves in a weakly relativistic non-Maxwellian plasma.** Borie, E. (Kernforschungszentrum Karlsruhe, ITP (Germany)); Moser, F.; Raeuchle, E.; Deike, R.A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

In the present work the influence of the electron distribution function on the dispersion and absorption of electromagnetic waves propagating at angles near 90 with respect to the magnetic field is investigated numerically using the dielectric tensor due to Orefice and coworkers for loss-cone type distributions, and to Bornatici et al for anisotropic Maxwellian distributions. Since the KfK gyrotron at 140 GHz has been used for ECW experiments at the Wendelstein 7-AS stellarator at IPP Garching, the numerical results for this contribution will focus on propagation of the extra-ordinary (X-) wave at frequencies near the second harmonic of the cyclotron frequency. (orig.)

23109 (IPP–III/186(v.1), pp. 71-84) **Propagation of electromagnetic radiation beams in the quasi-optical approximation.** Lontano, M. (Ist. di Fisica del Plasma, Associazione EURATOM-ENEA-CNR, Milan (Italy)); Tartari, U. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

An approximated theory is developed, based on the quasi-optical approximation, widely used in non-linear optics, to describe the propagation of an electromagnetic radiation beam in a dispersive anisotropic medium. The method is based on the description of (a) the propagation of a reference (or central) ray trajectory, according to the standard geometrical optics (that is for zero radiation wavelength), and (b) the evolution of the electric field (amplitude and polarization) around this trajectory by a diffusion-like differential equation. A further simplification of the description of the beam dynamics, in terms of the lowest order moments of the electromagnetic energy density distribution, is also disussed. (orig.)

23110 (IPP–III/186(v.1), pp. 85-98) **Gaussian beam propagation in quasi-optical systems and magnetoactive plasmas.** Nowak, S. (Ist. di Fisica del Plasma del CNR, Associazione EURATOM-ENEA-CNR, Milan (Italy)); Orefice, A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Highly collimated microwave beams, such as Gaussian beams of limited transverse extent, are largely employed, in the millimeter wavelength range, in the quasi-optical lines of most of the high frequency diagnostic experiments in thermonuclear plasmas like, for instance, those based on Electron Cyclotron Resonance Heating (ECRH) or on Collective Thomson Scattering (CTS). The propagation of these beams is therefore of crucial interest for many technical and scientific purposes like, for example, the optimization of quasi-optical components for transmission lines and for the control of the power deposition profile at very high density, the study of local heat transport and the stabilization of MHD modes. (orig.)

23111 (IPP–III/186(v.1), pp. 99-110) **Prospects of electron cyclotron emission for diagnosing non-thermal distribution functions.** Airoldi, A. (Ist. di Fisica del Plasma, Associazione EURATOM-CNR-ENEA, Milan (Italy)); Ramponi, G. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Electron Cyclotron Emission may be used for diagnosing non thermal electron distribution functions generated by radio frequency current drive. Our attention is concentrated in the X-mode downshifted second harmonic range of frequencies, by inspecting at the radiation collected in the horizontal low magnetic field side of a tokamak. The cutoff presence eliminates the thermal first harmonic emission and the non thermal one may be observed without other inference. The electron distribution function is modelled by a suitable sum of drifting maxwellians for reproducing the flat tails usually obtained in presence of lower hybrid power injection. This model is time saving as far as the computer simulations are concerned and permits at lot of runs in order to accomplish a wide parameters exploitation. A sensitivity analysis, in order to single out the influence of each parameter on ECE when non thermal electron distribution functions are present, is performed for a JET-like plasma. Good estimate for the perpendicular temperature and the spatial distribution may be deduced. The parallel energy and the number of suprathermal electrons are linked in such a way that it is an intriguing matter to clearly separate their effects by ECE alone. The rational suggestion is for a contemporary utilization of ECE and data of different diagnostic, as the fast electron bremsstrahlung together with the knowledge of the radio frequency sustained current. Taking into account this supplementary information, the fast electrons characterization may be obtained by fitting procedures. (orig.)

23112 (IPP–III/186(v.1), pp. 111-122) **Diagnosing fast electron diffusion by EC radiation.** Giruzzi, G. (Association EURATOM-CEA sur la Fusion, Dept. de Recherches sur la Fusion Controlee, Centre d'Etudes de Cadarache, 13 - Saint Paul-lez-Durance (France)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462--: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and*

electron cyclotron resonance heating. Vol. 1. Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of the radial diffusion of fast electrons in tokamak plasmas and its impact on EC diagnostics is investigated. A 3-dimensional Fokker-Planck code has been developed describing the evolution of the electron distribution function under the action of Coulomb collisions, dc electric fields, RF heating and radial diffusion induced by turbulent magnetic fields. The numerically computed distribution function can be used to evaluate electron cyclotron emission or transmission spectra for any harmonic or propagation angle by means of a radiation code including 3-dimensional ray-tracing for a multiple-ray system modelling the finite width of the radiated beams. This numerical tool is applied to investigate fast electron diffusion both in Ohmic and in LHCD plasmas. In Ohmic plasmas, non-Maxwellian distributions are generated by the radial diffusion process in the pressure gradient region; it is shown that ECE in the equatorial plane is not suitable for detecting such non-Maxwellian features, whereas vertical emission of transmission measurements on non-central chords yields, in principle, detailed information on the structure of the superthermal electron distribution. This indirect effect can be used to investigate the radial structure and properties of the turbulent fields. In LHCD plasmas, the possibility of diagnosing fast electron diffusion by ECE in the equatorial plane at large toroidal angles and frequencies between the first and second harmonic is analyzed and discussed. (orig.)

23113 (IPP–III/186(v.1), pp. 123-141) **Radial profile of the electron distribution from electron cyclotron emission measurements.** Tribaldos, V. (Associacion EURATOM-CIEMAT para Fusion, Madrid (Spain)); Krivenski, V. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

A numerical study is presented, showing the possibility to invert the electron distribution function from a small set of non-thermal emission spectra, for a regime of lower hybrid current drive. (orig.)

23114 (IPP–III/186(v.1), pp. 143-155) **Fokker-Planck simulations of ECRH experiments on the RTP tokamak.** Peeters, A.G. (FOM-Instituut voor Plasmaphysica 'Rijnhuizen', Association EURATOM-FOM, Nieuwegein (Netherlands)); Westerhof, E.; Cruz, D.F. da. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The ECRH experiments on the RTP tokamak have been simulated with a Fokker-Planck code. Simulated and measured soft X-ray spectra are compared both for Ohmic and ECR heated discharges, and are found to agree well. The ECRH discharges show a large local increase in conductivity and kinetic energy compared to a thermal plasma. The global changes were, however, much smaller. This in contrast to Ohmic discharge with comparable density, for which the local changes are smaller, but the global changes are larger. The experiments on ECCD only yielded an upper limit of the efficiency of 0.04 A/W, which is well below linear predictions $\approx$0.2 A/W. The Fokker-Planck code calculations indicate that this discrepancy cannot be explained by the reduction of the ECCD efficiency with increasing power, nor by a reduction due to radial transport. (orig.)

23115 (IPP–III/186(v.1), pp. 157-158) **A note on possible occurrence of electron wave trapping in ECRH.** Pozzoli, R. (Dipt. di Fisica, Universita degli Studi, Milan (Italy)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication ECR HEATING/trapped electrons; ELECTRON PLASMA WAVES; CYCLOTRON HARMONICS; PLASMA

23116 (IPP–III/186(v.1), pp. 159-174) **The potential of ECE measurements on next step tokamaks.** Costley, A.E. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking); Bartlett, D.V. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The likely role of diagnostics on next step tokamaks such as ITER is outlined. The physics effects which will limit the potential of ECE as a useful diagnostic are identified and examples given of the limits that they will set. Key practical problems that will be experienced in the implementation of ECE are identified, and important areas for future research and development are highlighted. (orig.)

23117 (IPP–III/186(v.1), pp. 175-189) **Laboratory test of an intensity interferometer for measurement of electron temperature fluctuations on Wendelstein 7-AS.** Sattler, S. (Max-Planck-Inst. fuer Plasmaphysik, Association EURATOM-IPP, Garching (Germany)); Hartfuss, H.J. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Transport relevant electron temperature fluctuations to be measured by electron cyclotron emission (ECE) radiometry might be buried completely in natural fluctuations of the ECE due to the thermal nature of this radiation. The spatial coherence properties of the fluctuations can be utilized in a correlation experiment to make temperature fluctuations accessible to measurement. An intensity interferometer, consisting of two identical 4-channel heterodyne radiometers with a common local oscillator and gaussian beam optics viewing the same emitting volume along crossed lines of sight, allows this type of measurements. With a specially developed quasithermal radiation source the correlation experiment was simulated and the intensity interferometer was tested. Measurements of the spatial coherence properties were in agreement with theoretical predictions. (orig.)

23118 (IPP–III/186(v.1), pp. 191-199) **Coherence properties of tokamak electron cyclotron emission fluctuations.** Cima, G. (Fusion Research Center, Texas Univ., Austin, TX (United States)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Thermal and nonthermal ECE fluctuations are investigated from the point of view of their space and time correlation properties. Plasma diagnostic implications are evaluated. Is everybody acquainted with an 'old fashioned' paradox known as Maxwell's demon? A quick reminder will help to get to the point. From J.C. Maxwell, letter to P.G. Tait: In short if heat is the motion of finite portions of matter and if we can apply tools to such portions of matter so as to deal with them separately, then we can take advantage of the different motion of different proportions to restore a uniformly hot system to unequal temperatures or to motions of large masses. Only we can't, not being clever enough (but a suitably clever enough being, the demon, could). (orig.)

23119 (IPP–III/186(v.1), pp. 201-209) **Measurements of electron cyclotron emission fluctuations in TEXT-U.** Kwon, M. (Auburn Univ., AL (United States)); Cima, G.; Gandy, R.F.; Patterson, D.M.; Phillips, P.E.; Roberts, D.R. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct

1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements of electron cyclotron emission (ECE) have been performed on TEXT-U with two heterodyne radiometers at two toroidal locations. A total of 16 channels, covering half of the plasma diameter in various magnetic fields, have been employed. The spatial resolution of the channels was varied by using IF filters with various widths to study the spatial correlation properties of the detected radiation. Toroidal cross correlation was also measured between channels on the same flux tube obtained by ramping the plasma current. Initial results show large, coherent MHD fluctuations and have allowed us to establish an upper bound for the higher frequency turbulent fluctuations. (orig.)

23120 (IPP–III/186(v.1), pp. 211-221) **Heat wave experiments on the W7-AS stellarator.** Hartfuss, H.J. (Max-Planck-Inst. fuer Plasmaphysik, Association EURATOM-IPP, Garching (Germany)); Erckmann, V.; Gasparino, U.; Giannone, L.; Maassberg, H. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

Power modulation with well localized ECRH power deposition at both 70 and 140 GHz, has been used to generate temperature perturbations which propagate away from the deposition region. Radiometry of the ECE is used to diagnose the generated temperature perturbation as a function of distance to the deposition zone. The decay of the amplitude and the delay of the wave provide the information to determine the electron thermal diffusivity. This value is then compared with the one derived from a global power balance. It is found that both values agree with the error bars. The technique has also been applied in recent experiments during L-H-mode transitions in W7-AS demonstrating a significant reduction in the effective heat diffusivity in the plasma core during the H-phase. The modulated ECRH causes a modulation of the Shafranov shift. Interference of the prompt shift with the heat wave results in an apparent asymmetry of the decay length of the heat wave with respect to the plasma centre. (orig.)

23121 (IPP–III/186(v.1), pp. 223-235) **Errors in transient electron temperature measurements.** Peters, M. (FOM-Instituut voor Plasmafysica 'Rijnhuizen', Association EURATOM-FOM, Nieuwegein (Netherlands)); Lopes Cardozo, N.J.; Hogeweij, G.M.D.; De Lucca, F.; Gorini, G. RTP Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

An overview is given of all relevant error sources in heat pulse propagation measurements and their impact on the results of transport analysis. A powerful method has been developed to estimate the magnitude of errors in heat pulse propagation measurements, induced by the nonlinear T_e-response and by the sensitivity to n_e of the ECE and Soft X-Ray diagnostics. The effect of the generation of higher harmonics due to the nonlinear T_e-response of the diagnostic is discussed. For ECH power modulation in RTP the experimental parameters are selected carefully in order to minimize error sources such as suprathermal ECE and plasma position modulation. Therefore: $q_a <$ or ≈ 4 and $2.5.10^{19}$ $m^{-3} < n_e(r=0) < 3.5.10^{19}$ m^{-3}. The resulting uncertainty of χ_e is smaller than 20-25% for recent experiments in RTP. (orig.)

23122 (IPP–III/186(v.1), pp. 237-249) **Detection of disruption precursors and study of disruption phenomena by ECE and collective scattering diagnostics.** Waidmann, G. (Inst. fuer Plasmaphysik, Forschungszentrum Juelich, Association EURATOM-KFA (Germany)); Kuang, G.; Jadoul, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

In a systematic study on plasma disruptions at TEXTOR MHD-modes and MARFES were detected as precursors to abrupt current terminations by ECE radiation. Different situations are presented where several MHD-modes appear simultaneously and lead to a minor or major disruption. The precursor MHD-oscillations are already visible in the collective scattering of a 150 GHz mm-wave. Highly enhanced density fluctuations are registered during mode locking and energy quench phases. A spectral study of the scattered radiation reveals characteristic properties of a turbulent plasma with high frequency density fluctuations. Prominent participants in the evolution to the turbulent state are the modes m/n=2/1 and m/n=1/1. A method is presented to identify these modes by a digital correlation technique in real time. Another type of instability encountered mainly during neutral beam heating and preceding a density limit disruption is the MARFE. A typical diagnostic feature of the MARFE is its drastical attenuation of ECE-radiation when it is received from the high field side of the machine. This property is used to recognize MARFEs and can be utilized to counteract by radially displacing the plasma away from the inboard side. Often the MARFE perturbation on the plasma boundary leads to strong radial plasma column oscillations which are detected by ECE. The appearance of the MARFE correlates very well with the sudden increase of the density turbulence level in the edge plasma prior to the final energy quench. (orig.)

23123 (IPP–III/186(v.1), pp. 251-263) **The JET ECE heterodyne radiometer and investigations of fast phenomena.** Bartlett, D.V. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking); Costley, A.E.; Jones, S.E.; Porte, L.; Smith, R.J. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper, the design and performance characteristics of the JET heterodyne radiometer are reviewed, and some novel aspects of the instrument are described. Areas where the radiometer could benefit from further improvement are highlighted, and those improvements currently in progress are discussed. Some measurements which demonstrate the radiometer's power as a diagnostic of fast phenomena are presented. (orig.)

23124 (IPP–III/186(v.1), pp. 265-276) **Effects of lower hybrid fast electron populations on electron temperature measurements at JET.** Tanzi, C.P. (FOM Instituut voor Plasmafysica 'Rijnhuizen', Nieuwegein (Netherlands)); Bartlett, D.V.; Kramer, G.J.; Schunke, B. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The Lower Hybrid Current Drive (LHCD) system on JET has to date achieved up to 1.5 MA of driven current. This current is carried by a fast electron population with energies more than ten times the electron temperature and density about 10^{-4} of the bulk plasma. This paper discusses the effects of this fast electron population on our ability to make reliable temperature measurements using ECE and reviews the effects on other plasma diagnostics which rely on ECE temperature measurements for their interpretation. (orig.)

23125 (IPP–III/186(v.1), pp. 277-288) **Analysis of electron cyclotron emission spectra of high electron temperature, supershot plasmas in TFTR.** Taylor, G. (Princeton Plasma Physics Lab., NJ (United States)); Arunasalam, V.; Efthimion, P.C.; Grek, B. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising

(Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

A primary objective of the TFTR program since 1986 has been the study and optimization of deuterium Supershot plasmas. These plasmas are predominantly heated by 90-110 keV neutral deuterium beams ($P_{NBI}/P_{OH}>30$), central ion temperatures are α30 keV and central electron temperatures from ECE (T_{ECE}) often exceed 10 keV. Central electron temperature data measured with a TV Thomson scattering (TVTS) system (T_{TVTS}) during the period 1987-1990 have been compared with data from three different ECE instruments on TFTR. Although $T_{ECE} \propto T_{TVTS}$ for temperatures below 6 keV, there is a systematically increasing disagreement at higher electron temperatures, with $T_{ECE} \propto 1.2\ T_{TVTS}$ for T_{TVTS} in the range 9-10 keV. Since the TVTS system measures the bulk temperature, for a bi-Maxwellian electron distribution T_{ECE} would be enhanced over T_{TVTS} by a factor which depends on the tail to bulk election density ratio and the hot tail temperature. This paper investigates whether the discrepancy between T_{TVTS} and T_{ECE} seen in TFTR Supershots at high electron temperatures is due to the presence of a hot electron tail component. The extraordinary mode ECE spectrum at the second, third and fourth harmonics is measured on the horizontal midplane by an absolutely calibrated ECE Michelson interferometer. This ECE spectrum is compared with the output from a time-independent transport code with relativistic opacity which solves the three-dimensional ECE radiation transport in a toroidally symmetric, two-dimensional geometry and uses measured electron density and temperature profiles from the TVTS system. (orig.)

23126 (IPP–III/186(v.1), pp. 291-304) **Overview of recent results from the Tore Supra ECE diagnostics.** Talvard, M. (Association EURATOM-CEA sur la Fusion, Centre d'Etudes de Cadarache, 13 - St. Paul-lez-Durance (France)); Liu, W.D.; Giruzzi, G. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

The Tore Supra ECE diagnostic system consists of a set of 3 Michelson and 12 Fabry-Perot interferometers, which is now fully operational. We present results obtained with the 3 Michelson during LHCD experiments first. It is shown how the sensitivity of the diagnostic to rather high $v_\perp$ prevents detection of $v_\parallel$ anisotropies. On the other hand, measurements during the Ohmic phase reveal some unexpected anisotropy which can be attributed to superthermal electrons related to the bootstrap current. The 12 Fabry-Perot have been operated using high acquisition sampling rates during pellet injection experiments. A shudder preceding the pellet itself is clearly evidenced just before an internal disruption occurs. During sawtooth activity, such measurements are also used to study the dynamics of the m=1, n=1 instability on the q=1 surface itself. (orig.)

23127 (IPP–III/186(v.1), pp. 305-313) **Density measurements in FTU from electron cyclotron emission.** Buratti, P. (Associazione EURATOM-ENEA sulla Fusione, CRE, Frascati (Italy)); Zerbini, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 318p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 1.* Order Number DE94773566. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper we present the results obtained on FTU tokamak (major radius R_0=0.935 m; limiter radius a=0.3 m; central toroidal magnetic field $B_0 \leq 8$ T) by means of an absolutely calibrated Fourier transform spectrometer with a time resolution of 5 ms and a spatial resolution of 0.03 m. Only ohmically heated thermal plasmas will be considered; data on suprathermal electron cyclotron emission are sparse at the moment and will be analyzed in future works. (orig.)

23128 (IPP–III/186(v.2)) **Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.** Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

The theory of electron cyclotron resonance phenomena is highly developed. The main theoretical tools are well established, generally accepted and able to give a satisfactory description of the main results obtained in electron cyclotron emission, absorption and current drive experiments. In this workshop some advanced theoretical and numerical tools have been presented (e.g., 3-D Fokker-Planck codes, treatment of the r.f. beam as a whole, description of nonlinear and finite-beam effects) together with the proposal for new scenarios for ECE and ECA measurements (e.g., for diagnosing suprathermal populations and their radial transport). (orig.)

23129 (IPP–III/186(v.2), pp. 315-328) **Electron cyclotron absorption measurements in Tore Supra during lower hybrid current drive.** Segui, J.L. (Association EURATOM-CEA sur la Fusion, Dept. de Recherche sur la Fusion Controlee, Centre d'Etudes de Cadarache, Saint Paul-lez-Durance (France)); Giruzzi, G.; Vezard, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

A transmission diagnostic system working in the frequency range 77-109 GHz has been implemented in the Tore Supra tokamak. It makes use of an ordinary mode launched along a vertical diameter, i.e., propagating along a nearly constant magnetic field. A modulation of the incident power allows to increase the signal to noise ratio. The purpose of the diagnostic is to measure electron cyclotron absorption (ECA) below the electron cyclotron frequency f_c in the presence of the fast electron tails created during lower-hybrid current drive. As is known, for a parallel electron tail, the absorption coefficient at $f<f_c$ is proportional to the parallel distribution function and a frequency scan yields, in principle, the shape of the parallel distribution as a function of the parallel momentum. The main advantages of ECA with respect to, e.g., electron cyclotron emission (ECE), are that the measurement is not affected by wall reflections and that the absorption coefficient is nearly independent of the perpendicular energy of the fast electrons. On the other hand, the measurement is affected by refraction effects, which can be calculated by means of a ray-tracing code and/or measured during similar ohmic plasmas. In both cases, measurements at a frequency where there is no absorption ($f_{max}>f_c$), are used as a reference. Parallel tail distributions measured by this method are presented and their relaxation properties are discussed. (orig.)

23130 (IPP–III/186(v.2), pp. 329-343) **The electron cyclotron absorption diagnostic for the JET pumped divertor plasma.** Smith, R.J. (JET Joint Undertaking, Abingdon, Oxon (United Kingdom)); Bartlett, D.V.; Costley, A.E.; Richards, S. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

We present the design of a diagnostic system to measure electron cyclotron absorption at the second harmonic E-mode resonance in the JET pumped divertor plasma. The diagnostic will measure transmission as a function of frequency along one or more sightlines from which the spatial profile of the $n_e T_e$ product will be deduced. The divertor is briefly described, and the electron cyclotron resonance physics relevant to this measurement is reviewed. The problems of measuring transmission using an oversized transmission system are discussed and the chosen measurement technique, a swept frequency interferometer using a

coherent radiation source, is described. A prototype of the instrument has been assembled to test the measurement technique. Some data demonstrating the instrument's characteristics are presented. The nonresonant losses, which may affect the interpretation of the measurement, are also discussed. (orig.)

23131 (IPP–III/186(v.2), pp. 345-360) **Implementation of oblique-incidence cyclotron wave transmission diagnostics.** Skiff, F. (Lab. for Plasma Research and Dept. of Physics, Maryland Univ., College Park, MD (United States)); Boyd, D.A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Practical aspects of the implementation of cyclotron wave transmission diagnostics are considered in three specific areas. Questions raised by the calculation of the diagnostic resolution and sensitivity, elimination of reflections through swept frequency and phase-coherent detection, and correcting for the effects of wave refraction through the use of equivalent rays are addressed. Results of preliminary tests and experiments as well as comments on future implementations are used to illustrate the discussion. (orig.)

23132 (IPP–III/186(v.2), pp. 361-367) **Effect on multiple reflection of electron cyclotron emission from optically thin plasmas.** Idei, H. (Dept. of Physics, Faculty of Sciences, Nagoya Univ. (Japan)); Kubo, S.; Hosokawa, M.; Iguchi, H.; Ohkubo, K.; Sato, T. CHS Group. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Frequency spectrum of second harmonic electron cyclotron emission was observed for optically thin plasma produced by fundamental electron cyclotron heating in Compact Helical System. Radial electron temperature profile deduced from this spectrum neglecting multiple reflection effect shows much difference from that measured by Thomson scattering. We relate the spectrum with electron temperature profile by the modified emission model including the scrambling effect. The scrambling effect results from both mode conversion and change in the trajectory due to multiple reflection of emitting ray at the vessel wall. The difference between two temperature profiles is explained well by using the modified emission model. (orig.)

23133 (IPP–III/186(v.2), pp. 369-379) **Development of neural network techniques for the analysis of JET ECE data.** Bartlett, D.V. (JET Joint Undertaking, Abingdon, Oxon (United Kingdom)); Bishop, C.M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports on a project currently in progress to develop neutral network techniques for the conversion of JET ECE spectra to electron temperature profiles. The aim is to obtain profiles with reduced measurement uncertainties by incorporating data from the LIDAR Thomson scattering diagnostic in the analysis, while retaining the faster time resolution of the ECE measurements. The properties of neural networks are briefly reviewed, and the reasons for using them in this application are explained. Some preliminary results are presented and the direction of future work is outlined. (orig.)

23134 (IPP–III/186(v.2), pp. 381-383) **ECE diagnostics on ASDEX upgrade.** Fuchs, J.C. (Association Max-Planck-Inst. fuer Plasmaphysik, EURATOM-IPP, Garching (Germany)); Eberhagen, A.; Salmon, N.A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

For measurement of the time and space resolved T_e-evolution of the ASDEX-Upgrade plasma an eight channel polychromator system was installed on the experiment together with a Michelson interferometer for determination of the whole ECE spectrum necessary, for instance, for the identification of a thermally radiating plasma being under investigation. In addition a heterodyne radiometer system has been designed and is now under construction and will be used for edge temperature measurement. A review will be given on the detailed setup of these instruments and first experimental results will be presented. (orig.)

23135 (IPP–III/186(v.2), pp. 385-396) **Heterodyne radiometer for the measurement of the electron temperature profile on TdeV.** Pinsonneault, D. (Centre Canadien de Fusion Magnetique, Varennes, Quebec (Canada)); Quirion, B.; Hubbard, A.; Glaude, V.; Legros, C. TdeV Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

In the following sections an overview of the basic physical considerations are presented. We then briefly describe the instrument and present the design and construction of the two calibration standards in more detail. We also discuss the calibration procedures using these sources which permit the derivation of T_e independent of the other diagnostics. Finally, a comparison of $T_e(R)$ profiles obtained with the three measurement system will be presented. (orig.)

23136 (IPP–III/186(v.2), pp. 397-408) **A new method used to calibrate Fabry-Perot interferometers on tokamaks.** Talvard, M. (Association EURATOM-CEA sur la Fusion, Centre d'Etudes de Cadarache, 13 - St. Paul-lez-Durance (France)); Javon, C.; Garcin, M.; Thouvenin, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Fabry-Perot interferometers are routinely used on the Tore Supra tokamak in order to measure the electron cyclotron emission spectrum especially in the optically thick region (150-300 GHz) for which the intensity is proportional to the electron temperature. In order to give the electron temperature in keV, it is necessary to calibrate the spectral measurements. In practice, one has to determine the calibration curve $C(\omega)$: $T_e(R(\omega))=I(\omega)/C(\omega)$ (keV), in which $I(\omega)$ is the spectral response in millivolt in the presence of plasma. (orig.)

23137 (IPP–III/186(v.2), pp. 409-416) **Quasioptical transmission system for ECE measurements on Alcator C-Mod.** Hsu, T.C. (MIT Plasma Fusion Center, Cambridge, MA (United States)); Hubbard, A.E.; Hutchinson, I.H.; Kominsky, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

A 10.8 meter quasioptical transmission line has been constructed for the ECE diagnostic system on Alcator C-Mod. The beamline is constructed around a pair of 20 cm diameter parabolic mirrors and will operate over the frequency range from 100 to 1000 GHz. The design, fabrication and performance of the ECE beamline are presented. A full-wave theoretical treatment of the optics is developed which allows the calculation of the point spread function for optical surfaces operating in submillimeter wavelengths. Results are compared with microwave measurements and excellent agreement is

obtained. The analysis is pertinent to the design of high resolution fluctuation diagnostics using ECE. (orig.)

23138 (IPP–III/186(v.2), pp. 417-422) **70 and 140 GHz notch-filters.** Geist, T. (Association Max-Planck-Inst. fuer Plasmaphysik, EURATOM-IPP, Garching (Germany)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Notch-filters are useful to reduce the stray gyrotron radiation reaching the ECE radiometer front-end. Constructions for 70 and 140 GHz are described. The 70 GHz notch-filter is realized by means of overmoded circular cavities coupled to a rectangular waveguide. The 140 GHz construction consists of a quasi-optical ring-resonator. (orig.)

23139 (IPP–III/186(v.2), pp. 481-495) **Recent results with 140 GHz ECRH at the W7-AS stellarator.** Erckmann, V. (Association Max-Planck-Inst. fuer Plasmaphysik, EURATOM-IPP, Garching (Germany)); Kasparek, W.; Mueller, G.A.; Schueller, P.G.; Borschegovsky, A.A.; Il'in, V.I. W7-AS Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments on high power plasma heating with 0.5 MW, 0.5 s Electron Cyclotron Resonance Heating (ECRH) at 140 GHz were performed for the first time at the W7-AS stellarator. The new ECRH system consists of a Russian gyrotron with lateral Gaussian output mode and a new quasi optical transmission line and launcher. The experiments were performed with low field side launch in the equatorial plane at the second harmonic X-mode. Net current free operation at plasma densities up to 1.2×10^{20} m^{-3} was achieved, which is the cut-off density for this frequency and mode at the resonant magnetic induction of 2.5 T. In contrast to the 70 GHz ECRH experiments on W7-AS, the extended density range gives access to plasma experiments with strong collisional electron-ion coupling. The high density operation is advantageous also because the plasma confinement in W7-AS shows a favourable density scaling. A combination of ECRH and NBI-heating, which inherently operates at high densities, will become possible in future experiments. Pilot experiments with high plasma densities during 140 GHz ECRH are discussed. During high density operation, H-mode transitions, which are well known from tokamaks, were observed for the first time in a stellarator. The operational window for these transitions and the correlated phenomena are presented. (orig.)

23140 (IPP–III/186(v.2), pp. 497-512) **On the second harmonic electron cyclotron resonance heating and current drive experiments on T-10 and DIII-D.** Lohr, J. (General Atomics, San Diego, CA (United States)); Forest, C.B.; Lin-Liu, Y.R.; Luce, T.C.; Harvey, R.W.; Downs, E.A.; James, R.A.; Bagdasarov, A.A.; Borshegovskii, A.A.; Chistyakov, V.V.; Dremin, M.M.; Gorshkov, A.V.; Gorelov, Yu.A.; Esipchuk, Yu.Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Studies of electron cyclotron current drive at the second harmonic resonance have been performed both on the DIII-D and T-10 tokamaks at injected power levels of approximately 0.5 MW. The DIII-D experiment used high field launch of the extraordinary mode at an angle of 15 to the radial. In this experiment, with pulse lengths $<$ or $\approx$500 msec, a loop voltage difference, compared to the value expected from the measured profiles, of $<$ or $\approx$50 mV was ascribed to approximately 50 kA of rf-driven current. When dc electric field and trapped particle effects were considered, this was consistent with theoretical predictions. T-10 experiments planned for the fall of 1992 will use low field launch of the extraordinary mode and an injection angle of 21 off-radial. In preliminary experiments with relatively poor machine conditions and pulse lengths $<$ or $\approx$400 msec, rf current drive was not observed despite the fact that driven currents as low as 10 kA, corresponding to a loop voltage difference for co- versus counter-injection of 20 mV, could have been detected. In this paper we examine the T-10 experiments using ray tracing and transport calculations in an attempt to understand the results. The dependence of the current drive efficiency on discharge parameters, flux penetration, and non-linear effects will be discussed. The results show that the launching geometry can have a significant effect on the observation of electron cyclotron current drive using the loop voltage as a diagnostic. In addition, predictions for the next series of experiments on T-10, for which greater than 2 MW of high frequency power should be available, will be presented. (orig.)

23141 (IPP–III/186(v.2), pp. 513-521) **Refraction, scattering, absorption and mode conversion of ECRH waves in RTP.** Smits, F.M.A. (DRFC/STIF CEA-Cadarache, 13 - Saint Paul-lez-Durance (France)); Oomens, A.A.M.; Bank, S.L.; Bongers, W.A. RTP-Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

A diagnostic, TraP, has been installed which measures the Transmitted Power fraction of one of the two additional Electron Cyclotron Heating sources on the RTP tokamak (R=0.72 m, $B_0 \leq 2.5$ T, a=0.164 m). The ECH power (60 GHz, 180 kW) of this source is launched in O-mode radially from the low field side into RTP. TraP is installed opposite to this launcher at the high field side to measure the transmitted power fraction. With TraP, studies on the refraction, scattering, absorption and mode conversion of the incoming beam have been performed. (orig.)

23142 (IPP–III/186(v.2), pp. 549-559) **Elliptical polarisation for oblique EC-wave launch.** Smits, F.M.A. (Association EURATOM-CEA sur la Fusion, Centre d'Etudes de Cadarache, 13 - St. Paul-lez-Durance (France)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Several applications of high power EC-waves in fusion devices require oblique launch in poloidal direction as well as in toroidal direction. For example, Electron Cyclotron Current Drive requires injection of the waves obliquely to the confining magnetic field to obtain an asymmetric heating in velocity space. For MHD mode stabilisation in present-day devices, variation of the poloidal injection angle is required to reach different flux surfaces. Furthermore, Electron Cyclotron Resonant Heating in fundamental X-mode from the High Field Side (HFS) increases the accessible density range for a given gyrotron frequency by a factor of two and is better absorbed than the O-mode, but requires oblique toroidal launching angles. Oblique launch of EC-waves in a magnetised plasma requires an elliptical polarisation of the wave. An overview of the requirements on the ellipticity is presented for all relevant cases, based on the coupling of the wave at the plasma edge using the cold plasma approximation. (orig.)

23143 (JAERI-M–93-184) **Ideal Magnetohydrodynamic stabilities in JT-60 and DIII-D tokamak plasmas.** Ozeki, Takahisa (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1993. 226p. Order Number DE94770684. Source: OSTI; NTIS; INIS.

Magnetohydrodynamic (MHD) instabilities of plasmas with a good (enhanced) energy confinement, obtained in the H-mode or after pellet injection in JT-60 and DIII-D tokamaks, are investigated. In enhanced-confinement plasmas, many kinds of MHD instabilities

occurred and they inhibit further improvement. In the present thesis, therefore, the mechanism of MHD stability is investigated by computational analysis, and ways to further improve the confinement by suppression of MHD instabilities are discussed. (J.P.N.).

23144 (JAERI-M–93-224) **Simulation of tearing mode stabilization by using ECH.** Kurita, Gen-ichi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Tuda, Takashi; Azumi, Masafumi; Takeda, Tatsuoki. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. 39p. Order Number DE94770700. Source: OSTI; NTIS; INIS.

Nonlinear simulations based on the reduced set of resistive MHD equations with the transport equation of electron temperature are carried out to investigate the effect of electron temperature perturbation induced by local heating of ECH on a tearing mode activity. Effect of poloidal plasma rotation is also considered in the simulations. It is shown that the local heating can suppress low-m tearing mode instability when O-point of the rotating magnetic island is effectively heated. Large parallel heat conduction causes the radially extending heat deposition profile for small width of magnetic island and magnitude of parallel heat conduction determines the heat power necessary for complete stabilization of the tearing mode. (author).

23145 (JAERI-M–93-228, pp. 1009-1016) **Neutron measurements as fusion plasma diagnostics.** Nishitani, Takeo (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Hoek, M. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. (CONF-9303258–: 5. international symposium on advanced nuclear energy research, Mito (Japan), 10-12 Mar 1993; JAERI-CONF–2). In *Proceedings of the fifth international symposium on advanced nuclear energy research: Neutrons as microscopic probes.* 1101p. Order Number DE94748692. Source: OSTI; NTIS; INIS.

Neutron measurements play important roles as the diagnostics of many aspects of the plasma in large tokamak devices such as JT-60U and JET. In the d-d discharges of JT-60U, the most important application of the neutron measurement is the investigation of the fusion performance using fission chambers. The ion velocity distribution function, and the triton slowing down are investigated by the neutron spectrometer and the 14 MeV neutron detector, respectively. TANSY is a combined proton-recoil and neutron time-of flight spectrometer for 14 MeV neutrons to be used during the d-t phase at JET. The detection principle is based on the measurements of the flight time of a scattered initial neutron and the energy of a corresponding recoil proton. The scattering medium is a polyethylene foil. The resolution and efficiency, using a thin foil (0.95 mg/cm^2), is 155 keV and 1.4×10^{-5} cm^2, respectively. (author).

23146 (JAERI-M–94-002) **Initial results from neutron yield measurements by activation technique at JT-60U.** Hoek, M. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Nishitani, Takeo; Ikeda, Yujiro; Morioka, Atsuhiko. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 32p. Order Number DE94770824. Source: OSTI; NTIS; INIS.

The time dependent 2.5 MeV neutron emission from JT-60U plasmas is routinely measured by fission chambers. The neutron yield measurements have now been complemented by time-integrated neutron activation technique utilizing Si-, Al-, In-, Cu-, Zn-, and Ni-foils. Neutron transport calculations have been performed using Monte Carlo trajectory sampling methods (MCNP code) in order to determine the neutron flux and energy distribution at the irradiation position. In the modeling of the geometry, the importance of the area around the irradiation point has been investigated in detail. The neutron activation system has just recently been installed at JT-60U. During the high βp experiments, 27-30 July -93, approximately 100 foils were irradiated. The preliminary results of the measurement of the 2.5 MeV neutron yield shows a good agreement with the neutron yield obtained from fission chambers. Among the foils, listed above, indium was the most convenient material due to high sensitivity and relatively low error of the measured neutron yield (≈15%). The 14 MeV neutron yield, obtained from fusion between tritium (T) (created from the second branch of fusion between deuterium (DD-reaction)) and deuterium, also gives reasonable values. In this case, silicon and aluminium were the most convenient materials due to high sensitivity, short half lives of the measured daughter nucleus and relatively low errors (≈15-20%). (author).

23147 (LA-UR–94-1832) **Conceptual design for a fast neutron ionization chamber for fusion reactor plasma diagnostics.** Sailor, W.C.; Barnes, C.W. Los Alamos National Lab., NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940630–9: 11. topical meeting on the technology of fusion energy, New Orleans, LA (United States), 19-24 Jun 1994). Order Number DE94013396. Source: OSTI; NTIS; INIS; GPO Dep.

A conceptual design for a radiation-hard "pointing" fast neutron ionization chamber that is capable of delivering a 1 MHz countrate of T(D,n) events at ITER is given. The detector will use a ~1 cm^3 volume of CO_2 fill gas at 0.1 bar pressure in a 500 V/cm electric field. The pulse widths will be ~10 ns, enabling it to operate in a flux of ~ 6×10^{13} DT n/cm^2/sec. A special collimator design is used, giving an estimated angular resolution of 4.5 degrees HWHM.

23148 (NIFS–240) **Ion heat pulse after sawtooth crash in the JFT-2M tokamak.** Miura, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Okano, F.; Suzuki, N.; Mori, M.; Hoshino, K.; Maeda, H.; Takizuka, T.; Itoh, K.; Itoh, S. National Inst. for Fusion Science, Nagoya (Japan). Aug 1993. 21p. Order Number DE94770685. Source: OSTI; NTIS; INIS.

The ion heat pulse after sawtooth crash is studied with the time-of-flight neutral measurement on the JFT-2M tokamak. The rapid change of the bulk ion energy distribution near the edge is observed after sawtooth crash. The delay time is measured and the effective measuring position is estimated by a neutral transport code, then the thermal conductivity, χ_i^{HP}, of about 15±10m^2/sec is evaluated for the L-mode plasma. The simple diffusive model with constant χ_i^{HP}, however, does not explain the amplitude of the pulse in the ion energy distribution. (author).

23149 (NIFS–241) **Observation of non diffusive term of toroidal momentum transport in the JFT-2M tokamak.** Ida, K.; Miura, Y.; Matsuda, T.; Itoh, K. National Inst. for Fusion Science, Nagoya (Japan). Aug 1993. 22p. Order Number DE94770686. Source: OSTI; NTIS; INIS.

Toroidal rotation velocity profiles are measured with multi-chord charge-exchange spectroscopy for the discharge that the neutral beams are interchanged from parallel (co) to anti-parallel (counter) to the direction of the plasma current. Transport analysis of toroidal momentum in the transient phase suggests the existence of non-diffusive term in the toroidal momentum transport. This non-diffusive term appears as spontaneous source of the toroidal momentum in the direction of anti-parallel to the plasma current. (author).

23150 (NIFS–242) **Discriminant analysis to predict the occurrence of ELMs in H-mode discharges.** Kardaun, O.J.W.F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany)); Itoh, S.; Itoh, K.; Kardaun, J.W.P.F. National Inst. for Fusion Science, Nagoya (Japan). Aug 1993. 59p. Order Number DE94770687. Source: OSTI; NTIS; INIS.

After an exposition of its theoretical background, discriminant analysis is applied to the H-mode confinement database to find the region in plasma parameter space in which H-mode with small ELMs (Edge Localized Modes) is likely to occur. The boundary of this region is determined by the condition that the probability of appearance of such a type of H-mode, as a function of the plasma parameters, should be (1) larger than some threshold value and (2) larger than the corresponding probability for other types of H-mode (i.e., H-mode without ELMs or with giant ELMs). In practice, the discrimination has been performed for the ASDEX, JET and JFT-2M tokamaks (a) using four instantaneous plasma parameters (injected power P_{inj}, magnetic field B_t, plasma current I_p and line averaged electron density (n-bar$_e$) and (b) taking also memory effects of the plasma and the distance between the plasma and the wall into account, while using variables that are normalised with respect to machine size. Generally speaking, it is found that there is a substantial overlap between the region of H-mode with small ELMs and the region of the two other types of H-mode. However,

the ELM-free and the giant ELM H-modes relatively rarely appear in the region, that, according to the analysis, is allocated to small ELMs. A reliable production of H-mode with only small ELMs seems well possible by choosing this regime in parameter space. In the present study, it was not attempted to arrive at a unified discrimination across the machines. So, projection from one machine to another remains difficult, and a reliable determination of the region where small ELMs occur still requires a training sample from the device under consideration. (author) 53 refs.

23151 (NIFS–243) **Modelling of transport phenomena.** Itoh, Kimitaka; Itoh, Sanae; Fukuyama, Atsushi. National Inst. for Fusion Science, Nagoya (Japan). Sep 1993. 40p. Order Number DE94770688. Source: OSTI; NTIS; INIS.

In this review article, we discuss key features of the transport phenomena and theoretical modelling to understand them. Experimental observations have revealed the nature of anomalous transport, i.e., the enhancement of the transport coefficients by the gradients of the plasma profiles, the pinch phenomena, the radial profile of the anomalous transport coefficients, the variation of the transport among the Bohm diffusion, Pseudo-classical confinement, L-mode and variety of improved confinement modes, and the sudden jumps such as L-H transition. Starting from the formalism of the transport matrix, the modelling based on the low frequency instabilities are reviewed. Theoretical results in the range of drift wave frequency are examined. Problems in theories based on the quasilinear and mixing-length estimates lead to the renewal of the turbulence theory, and the physics picture of the self-sustained turbulence is discussed. The theory of transport using the fluid equation of plasma is developed, showing that the new approach is very promising in explaining abovementioned characteristics of anomalous transport in both L-mode and improved confinement plasmas. The interference of the fluxes is the key to construct the physics basis of the bifurcation theory for the L-H transition. The present status of theories on the mechanisms of improved confinement is discussed. Modelling on the nonlocal nature of transport is briefly discussed. Finally, the impact of the anomalous transport on disruptive phenomena is also described. (author) 95 refs.

23152 (NIFS–244) **Averaged resistive MHD equations.** Todoroki, Jiro. National Inst. for Fusion Science, Nagoya (Japan). Sep 1993. 19p. Order Number DE94770689. Source: OSTI; NTIS; INIS.

Averaged resistive MHD equations are derived by using the Lagrangian formalism. The assumption is that the perturbation is of single toroidal harmonics on the special magnetic coordinates Jacobian of which is independent of the toroidal angle. The metrics contained in the obtained resistive equations are those appearing in the averaged equilibrium equations. The local stability conditions are also derived. (author).

23153 (NIFS–245) **The origin of collisionless dissipation in magnetic reconnection.** Tanaka, Motohiko. National Inst. for Fusion Science, Nagoya (Japan). Sep 1993. 20p. Order Number DE94770703. Source: OSTI; NTIS; INIS.

The mechanism of collisionless reconnection in magnetized plasmas is studied in terms of coalescence of two flux tubes using implicit particle simulation. The motional electric field resulting from magnetic attraction generates the non-MHD (magneto-hydrodynamic), scalar electrical potential of a quadrupole configuration across the x-point. This electric field transports the plasma and magnetic flux into and out of the diffusion layer, and also accelerates the finite mass electrons to produce the current $J_{parallel}$ along the helical magnetic field. These processes provide equivalent dissipation which makes magnetic reconnection possible in collisionless magnetized plasmas. (author).

23154 (NIFS–246) **Current diffusive ballooning mode in second stability region of tokamaks.** Yagi, M. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Itoh, K.; Itoh, S.; Fukuyama, A.; Azumi, M. National Inst. for Fusion Science, Nagoya (Japan). Sep 1993. 20p. Order Number DE94770690. Source: OSTI; NTIS; INIS.

Stability of the current diffusive ballooning mode in tokamaks with high toroidal mode number is analyzed in the region of second-stability against the ideal magnetohydrodynamic mode. It is found that the growth rate of the current diffusive ballooning mode is decreased by the reduction of the geodesic curvature driving force. The reduction of thermal conductivity in the limit of very weak shear or negative shear in comparison with standard shear is also shown. (author).

23155 (NIFS–247) **Trapped electron instabilities due to electron temperature gradient and anomalous transport.** Yamagishi, T. (Fukui Inst. of Technology (Japan)). National Inst. for Fusion Science, Nagoya (Japan). Oct 1993. 22p. Order Number DE94770770. Source: OSTI; NTIS; INIS.

The electrostatic trapped electron instabilities have been investigated by numerically solving the local single energy integral form dispersion relation. With the electron temperature gradient, the electron collision effect destabilizes the dissipative trapped electron mode (DTEM). For collisionless electrons, the energy dependent curvature drift effect strongly destabilizes the collisionless trapped electron mode. The growth rate is, however, reduced by a small collision effect. The anomalous transport due to these trapped electron modes is discussed. (author).

23156 (NIFS–249) **Monte Carlo simulation study of the ICRF minority heating in the Large Helical Device.** Murakami, S.; Okamoto, M.; Nakajima, N.; Ohnishi, M.; Okada, H. National Inst. for Fusion Science, Nagoya (Japan). Oct 1993. 39p. Order Number DE94770771. Source: OSTI; NTIS; INIS.

A Monte Carlo simulation code is developed for the ICRF heating in helical systems, which takes into account finite beta effects, complicated orbits of high energetic particles, Coulomb collisions, and interactions between the particles and the applied waves. The code is used to investigate the ICRF minority heating in the Large Helical Device. The configuration of the magnetic fields changes significantly due to finite beta effects in the Large Helical Device. The resonance layer position is found to be crucial to the heating efficiency as the plasma beta increases. When the strength of the resonance magnetic field is set to the value at the magnetic axis, the higher heat efficiency is obtained and no clear difference of the heat efficiency due to the finite beta effects is found at the high ICRF wave power region. However the radial profile of the transferred power to majority ions and electrons from minority ions changes by the deformation of the trapped particle orbits due to the finite beta effects. The heat efficiency is improved if the radial electric field, E_r, is positive (E_r is directed radially outward) and it is also improved by supplying ^3He minority ions rather than proton minority ions. (author).

23157 (NIFS–257) **Temporal behavior of the electron density profile during limiter biasing in the HYBTOK-II tokamak.** Sasaki, S. (Nagoya Univ. (Japan). Faculty of Engineering); Uesugi, Y.; Takamura, S.; Sanuki, H.; Kadota, K. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 17p. Order Number DE94770609. Source: OSTI; NTIS; INIS.

A rapid change in the detailed edge electron density profile during positively biased limiter experiment is obtained with high temporal resolution of $\approx$20 μs using a laser blow-off lithium beam probe technique in HYBTOK-II tokamak. The transient change in the electron density profile and the movement of the position where a steep density gradient is formed are experimentally observed. The temporal behavior of the electron density profile correlates well with reductions in the biasing current and H_α emission in the scrape-off layer, and the suppression of electrostatic fluctuations near the edge of the core region. (author).

23158 (NIFS–262) **Some theoretical problems of magnetic diagnostics in tokamaks and stellarators.** Pustovitov, V.D. National Inst. for Fusion Science, Nagoya (Japan). Dec 1993. 23p. Order Number DE94770599. Source: OSTI; NTIS; INIS.

The main problem of magnetic diagnostics is discussed here: which plasma characteristics can be determined from magnetic measurements in tokamaks and stellarators. The reasons are elucidated why diamagnetic measurements are reliable and easily interpreted. We discuss also the capabilities of diagnostics based on the measurements of poloidal fields outside the plasma. This article is based on a lecture delivered at the Third International School on Plasma Physics and Controlled Fusion, held 15-22 June 1993 at St. Petersburg - Kizhi, Russia. (author).

23159 (NIFS–263) **A study of non-ideal focus properties of 30deg parallel plate energy analyzers.** Fujisawa, A.; Iguchi, H.; Hamada, Y. National Inst. for Fusion Science, Nagoya (Japan). Dec 1993. 26p. Order Number DE94770608. Source: OSTI; NTIS; INIS.

A succinct model is proposed to describe non-ideal characteristics owing to electric field penetration into the drift region in actual parallel plate energy analyzers. A good agreement has been obtained between the theoretically expected and experimentally observed focus properties of the 30deg parallel plate analyzer. (author).

23160 (NIFS–266) **A research of possibility for negative muon production by a low energy electron beam accompanying ion beam.** Uramoto, Joshin. National Inst. for Fusion Science, Nagoya (Japan). Dec 1993. 40p. Order Number DE94770600. Source: OSTI; NTIS; INIS.

A low energy electron beam ($\leq$ 2000 eV) is injected perpendicularly to a uniform magnetic field, together with a low energy positive ion beam. On this magnetic mass analysis (using the uniform magnetic field), a peak of secondary electron current to the beam collector (arranging as a mass analyzer of 90deg type), appears at an analyzing magnetic field which corresponds exactly to a relation of negative muon μ^- (the mass m=207 m_e and the charge q=e, where m_e and e are mass and charge of electron). The ion beam is essential for the peak appearance, which is produced by decelerating electrically the electron beam in front of the entrance slit of the mass analyzer, and by introducing a neutral gas into the electron beam region and producing a plasma through the ionization. We consider that a very small amount of negative muons may be produced through local cyclotron motions of the injected beam electrons in the ion beam or by an interaction between the bunched beam electrons and beam ions. (author).

23161 (NIFS-MEMO–12) **Chaotic phenomena in plasma 3.** Kawai, Y. (Kyushu Univ., Fukuoka (Japan)). National Inst. for Fusion Science, Nagoya (Japan). Oct 1993. 129p. (In Japanese, English). Order Number DE94770765. Source: OSTI; NTIS; INIS.

To review the present status of the research on plasma chaos, a working group was organized in 1990 as a collaboration research of National Institute for Fusion Science and ended on March 1993. This is the report on the activity which contains both experimental and theoretical works. (author) 139 refs.

23162 (NIFS-PROC–14, pp. 29-42) **An unstable motion of plasma in toroidal z-pinch discharge.** Shimizu, Norio (Utsunomiya Univ. (Japan). Faculty of Engineering); Matsuura, Kenya; Shibata, Kanetoshi. National Inst. for Fusion Science, Nagoya (Japan). Jul 1993. (CONF-9212107–: Research meeting on 'physics and application on Z-pinches', Nagoya (Japan), 11-12 Dec 1992). In *Physics and application of high density Z-pinches.* 106p. Order Number DE94737967. Source: OSTI; NTIS; INIS.

The MHD instabilities in a z-pinch discharge have experimentally investigated with a toroidal plasma device. The investigations are mainly made by measuring poloidal magnetic fields with a poloidal array of small coils. Especially, the motions of the center of plasma column are observed in relation to m=1 poloidal mode. The experimental results in the unstable case of the low bias magnetic field show that the plasma column experiences a large toroidal drift in the initially rising stage of plasma current and oscillates after that stage. The experimental values for the periods of the oscillatory motions of plasma column are in good accordance with the theoretical values given by MHD theory. (author).

23163 (NIFS-PROC–14, pp. 43-51) **Dynamic behavior of a gas-puff z-pinch plasma and x-ray radiation.** Moriyama, Kinya (Nihon Univ., Tokyo (Japan). Coll. of Science and Technology); Suzuki, Hideaki; Takasugi, Keiichi; Miyamoto, Tetsu. National Inst. for Fusion Science, Nagoya (Japan). Jul 1993. (CONF-9212107–: Research meeting on 'physics and application on Z-pinches', Nagoya (Japan), 11-12 Dec 1992). In *Physics and application of high density Z-pinches.* 106p. Order Number DE94737967. Source: OSTI; NTIS; INIS.

A gas-puff z-pinch plasma was produced in the SHOTGUN device, in which a hollow initial gas is injected through an annular nozzle on the anode. The contracting plasma showed nonuniformity along the column axis. As the rippling develops, the plasma column is separate into sections, which shrinks by turns from the gas nozzle. The spot images in the x-ray photograph corresponds to the nodes of the rippling. (author).

23164 (NIFS-PROC–14, pp. 52-61) **Effect of operating gas on the x-ray radiation from a gas-puff z-pinch.** Suzuki, Hideaki (Nihon Univ., Tokyo (Japan). Coll. of Science and Technology); Moriyama, Kinya; Takasugi, Keiichi; Miyamoto, Tetsu. National Inst. for Fusion Science, Nagoya (Japan). Jul 1993. (CONF-9212107–: Research meeting on 'physics and application on Z-pinches', Nagoya (Japan), 11-12 Dec 1992). In *Physics and application of high density Z-pinches.* 106p. Order Number DE94737967. Source: OSTI; NTIS; INIS.

Gas-puff z-pinch plasma using Ne, Ar and Kr as pinch materials have been produced in the SHOTGUN device. The hardening of x-ray radiation with z of the operating gas was confirmed. The magnetic energy converted into the kinetic energy of the plasma increased with z of the gas. It is attributed to strong compression due to radiation cooling in the contraction phase. (author).

23165 (NIFS-PROC–14, pp. 62-68) **Semi-automated data acquisition-and processing system for a Mach-Zehnder interferometer.** Iwai, K. (Gunma Univ., Kiryu (Japan). Faculty of Engineering); Yosida, M.; Kitaoka, H.; Hirano, K. National Inst. for Fusion Science, Nagoya (Japan). Jul 1993. (CONF-9212107–: Research meeting on 'physics and application on Z-pinches', Nagoya (Japan), 11-12 Dec 1992). In *Physics and application of high density Z-pinches.* 106p. Order Number DE94737967. Source: OSTI; NTIS; INIS.

A simple image acquisition system for an interferometer and image processing technique are described. In this system, commercially supplied tools are used and specific software is developed to perform a semi-quantitative analysis of interferogram. The computer program written in the C language is developed to carry out the thinning of the fringes. The response of the system is evaluated using the contrast transfer function (CTF). The thinning is carried out by the fringes being acquired into the image processing system and detected the maximum luminosity of the fringes with in a limit of the CTF. These techniques are examined using an interferogram obtained in plasma focus experiment. (author).

23166 (NIFS-TECH–3) **Development of high performance Schottky barrier diode and its application to plasma diagnostics.** Fujita, Junji (and others); Kawahata, Kazuo; Okajima, Shigeki. National Inst. for Fusion Science, Nagoya (Japan). Oct 1993. 92p. (In Japanese, English). Order Number DE94770683. Source: OSTI; NTIS; INIS.

At the conclusion of the Supporting Collaboration Research on 'Development of High Performance Detectors in the Far Infrared Range' carried out from FY1990 to FY1992, the results of developing Schottky barrier diode and its application to plasma diagnostics are summarized. Some remarks as well as technical know-how for the correct use of diodes are also described. (author).

23167 (ORNL/FTR–4871) **Travel to France to participate in the collaboration between Fusion Energy Division and Tore Supra on edge plasma and particle control: Foreign trip report, November 12–December 5, 1993.** Hogan, J.T. Oak Ridge National Lab., TN (United States). 20 Dec 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004748. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This three week visit was devoted mainly to work on topics related to impurity generation and transport from Tore Supra plasma facing components. Past results from the traveler's calculations with the BBQ code formed the basis for analysis of impurity generation from the Tore Supra inner wall and from the neutralizer plate of the outboard pump limiter. New results were presented for impurity generation from the face of the outboard limiter and from the ion cyclotron heating (ICH) antennas. New projects were initiated during this visit to, assess the inner wall, lower pump limiters (with emphasis on thermal runaway events) and the lower hybrid grilles. Work on inner wall charge exchange particle exchange was continued. A talk was presented at the annual Steering Committee meeting for this USDOE/CEA exchange.

23168 (PPPL–2989) **Utility of extracting α-particle energy by waves.** Fisch, N.J.; Herrmann, M.C. Princeton Univ., NJ (United States). Plasma Physics Lab. May 1994. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94012553. Source: OSTI; NTIS; INIS; GPO Dep.

The utility of extracting α-particle power, and then diverting this power to fast fuel ions, is investigated. As power is diverted to fast ions and then to ions, a number of effects come into play, as the relative amounts of pressure taken up by electrons, fuel ions, and fast α-particles shift. In addition, if the α-particle power is diverted to fast fuel ions, there is an enhanced fusion reactivity because of the nonthermal component of the ion distribution. Some useful expressions for describing these effects are derived, and it is shown that fusion reactors with power density about twice what otherwise might be obtained can be contemplated, so long as a substantial amount of the α-particle power can be diverted. Interestingly, in this mode of operation, once the electron heat is sufficiently confined, further improvement in confinement is actually not desirable. A similar improvement in fusion power density can be obtained for advanced fuel mixtures such as D-He^3, where the power of both the energetic α-particles and the energetic protons might be diverted advantageously.

23169 (PPPL–2994) **Alpha particle effects on the internal kink and fishbone modes.** Wu, Y.; Cheng, C.Z.; White, R.B. Princeton Univ., NJ (United States). Plasma Physics Lab. Jun 1994. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94013104. Source: OSTI; NTIS; INIS; GPO Dep.

The effects of alpha particles on the internal kink and fishbone modes are studied analytically. The nonadiabatic contribution from untrapped alpha particles is negligible. Finite inverse aspect ratio, plasma β and plasma shaping effects can significantly enhance the trapped particle drift reversal domain in the pitch angle space and reduce the bounce-averaged magnetic drift frequency. The drift reversal effect on the ideal kink mode is small, but the β_α threshold for the fishbone mode can be much lower than previously predicted. Moreover, the fishbone mode could be excited by alpha particles even when the plasma is stable in the ideal MHD limit. In addition, the ion diamagnetic drift frequency (finite ion Larmor radius effect) has a strong destabilizing effect on the fishbone mode when it is comparable with the trapped alpha averaged precessional drift frequency, even though it stabilizes the plasma in the ideal MHD limit.

23170 (PPPL-Q–50) **Princeton Plasma Physics Laboratory annual report, October 1, 1991–September 30, 1992.** Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 208p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94012306. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: Principal parameters achieved in experimental devices for fiscal year 1992; tokamak fusion test reactor; princeton beta experiment-modification; current drive experiment-upgrade; tokamak physics experiment/steady-state advanced tokamak; international thermonuclear experimental reactor; international collaboration; x-ray laser studies; plasma processing: Deposition and etching of thin films; pure electron plasma experiments; theoretical studies; tokamak modeling; high-field magnet project; engineering department; environment, safety, and health and quality assurance; technology transfer; office of human resources and administration; PPPL invention disclosures for fiscal year 1992; office of resource management; graduate education: plasma physics; graduate education: program in plasma science and technology; and science education program.

23171 (PPPL-TH–93-3) **Princeton University Plasma Physics Laboratory Theory Division quarterly report, July 1–September 30, 1993.** Princeton Univ., NJ (United States). Plasma Physics Lab. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94013102. Source: OSTI; NTIS; GPO Dep.

This report discusses: Comparisons of gyrofluid and gyrokinetic simulations and recent advances in gyrokinetic theory.

23172 (UCRL-ID–117214) **Three-dimensional gyrokinetic particle-in-cell simulation of plasmas on a massively parallel computer: Final report on LDRD Core Competency Project, FY 1991–FY 1993.** Byers, J.A.; Williams, T.J.; Cohen, B.I.; Dimits, A.M. Lawrence Livermore National Lab., CA (United States). 27 Apr 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94013367. Source: OSTI; NTIS; INIS; GPO Dep.

One of the programs of the Magnetic fusion Energy (MFE) Theory and computations Program is studying the anomalous transport of thermal energy across the field lines in the core of a tokamak. We use the method of gyrokinetic particle-in-cell simulation in this study. For this LDRD project we employed massively parallel processing, new algorithms, and new algorithms, and new formal techniques to improve this research. Specifically, we sought to take steps toward: researching experimentally-relevant parameters in our simulations, learning parallel computing to have as a resource for our group, and achieving a 100 x speedup over our starting-point Cray2 simulation code's performance.

23173 (UCRL-JC–115423) **The role of heating and current drive in ITER.** Nevins, W.M.; Haney, S. Lawrence Livermore National Lab., CA (United States). 18 Oct 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9310322–1: International thermonuclear experimental reactor radio frequency technical meeting, Garching (Germany), 21-27 Oct 1993). Order Number DE94012679. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses and summarize the role of heating and non-inductive current drive in ITER as: (1) ITER must have heating power sufficient for ignition. (2) The heating system must be capable of current drive. (3) Steady-state operation is an "ultimate goal." It is recognized that additional heating and current drive power (beyond what is initially installed on ITER) may be required. (4) The "Ultimate goal of steady-state operation" means steady-state with $Q_{CD} \geq 5$. Unlike the "Terms of Reference" for the ITER CDA, the "ITER Technical Objectives and Approaches" for the EDA sets no goal for the neutron wall load during steady-state operation. (5) In addition to bulk current drive, the ITER heating and current drive system should be used for current profile control and for burn control.

23174 (UCRL-JC–116269) **Motional stark effect upgrades on DIII-D.** Rice, B.W.; Nilson, D.G.; Wroblewski, D. Lawrence Livermore National Lab., CA (United States). Apr 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ; AC03-84ER51044. (CONF-940552–8: 10. topical conference on high-temperature plasma diagnostics, Rochester, NY (United States), 8-12 May 1994). Order Number DE94013146. Source: OSTI; NTIS; INIS; GPO Dep.

The measurement and control of the plasma current density profile (or q profile) is critical to the advanced tokamak program on DIII-D. A complete understanding of the stability and transport properties of advanced operating regimes requires detail poloidal field measurements over the entire plasma radius from the core to the edge. In support of this effort, the authors have recently completed an upgrade of the existing MSE diagnostic, increasing the number of channels from 8 to 16. A new viewing geometry has been added to the outer edge of the plasma which improves the radial resolution in this region from 10 cm to < 4 cm. This view requires the use of a reflector that has been designed to minimize polarization amplitude and phase effects. Vacuum-compatible polarizers have also been added to the instrument for in-situ calibration. Future use of the MSE diagnostic for feedback control of the q profile will also be discussed.

23175 (UCRL-JC–116270) **Design of the divertor Thomson scattering system on DIII-D.** Carlstrom, T.N. (General Atomics, San Diego, CA (United States)); Foote, J.H.; Nilson, D.G.; Rice, B.W. Lawrence Livermore National Lab., CA (United States). May 1994. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ; AC03-89ER51114. (CONF-940552–7: 10. topical conference on high-temperature plasma diagnostics, Rochester, NY (United States), 8-12 May 1994). Order Number DE94012672. Source: OSTI; NTIS; INIS; GPO Dep.

Local measurements of n_e and T_e in the divertor region are necessary for a more complete understanding of divertor physics. We have designed an extension to the existing multipulse Thomson scattering system to measure n_e in the range 5×10^{18} to 5×10^{20} m^{-3} and T_e 5–500 eV, with 1 cm resolution from 1–21 cm above the floor of the DIII-D vessel, in the region of the X-point for lower single-null diverted plasmas. One of the existing 8, 20 Hz, ND:YAG lasers will be redirected to a separate vertical port, and viewed radially with a specially designed, f/6.8 lens. Fiber optics carry the light to additional polychromators whose interference filters have been optimized for low T_e measurements. Other aspect of the system, including the beam path to the vessel, polychromator design, real time data acquisition, laser control, calibration facility, and DIII-D timing and data acquisition interface will be shared with the existing multipulse Thomson system. An in-situ laser alignment monitor will provide alignment information for each laser pulse.

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Refer also to citation(s) 21960, 22023, 22235, 22902, 22942, 22943, 22987, 22993, 23083, 23095, 23138, 23166, 23169

23176 (ANL/ET/CP–81391) **Transient thermal and dynamic stresses in strongback-design blankets.** Majumdar, S. Argonne National Lab., IL (United States). [1994]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–5: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94012639. Source: OSTI; NTIS; INIS; GPO Dep.

Transient thermal stresses of the first wall are compared for strongback-design blankets that contain stainless steel, ferritic steel, or a vanadium alloy as structural materials. Transient dynamics stresses due to plasma disruptions are computed on a parametric basis. Disruption loading characteristics, for which transient effects are important, are identified. Also explored are the relative merits of supporting the blanket at the top versus the bottom from the standpoint of dynamic stresses.

23177 (ANL/ET/CP–81527) **Development of intermetallic coatings for fusion power applications.** Park, J.H.; Domenico, T.; Dragel, G.; Clark, R. Argonne National Lab., IL (United States). Mar 1994. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–1: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94012647. Source: OSTI; NTIS; INIS; GPO Dep.

In the design of liquid-metal cooling systems, corrosion resistance of structural materials and magnetohydrodynamic (MHD) force and its subsequent influence on thermal hydraulics and corrosion are major concerns. The objective of this study is to develop stable corrosion-resistant electrical insulator coatings at the liquid-metal/structural-material interface, with emphasis on electrically insulating coatings that prevent adverse MHD-generated currents from passing through the structural walls. Vanadium and V-base alloys are potential materials for structural applications in a fusion reactor. Insulator coatings inside the tubing are required when the system is cooled by liquid metals. Various intermetallic films were produced on V, V-t, and V-20 Ti, V-5Cr-t and V-15Cr-t, and Ti, and Types 304 and 316 stainless steel. The intermetallic layers were developed by exposure of the materials to liquid lithium of 3–5 at.% and containing dissolved metallic solutes at temperatures of 416–880°C. Subsequently, electrical insulator coatings were produced by reaction of the reactive layers with dissolved nitrogen in liquid lithium or by air oxidation under controlled conditions at 600–1000°C. These reactions converted the intermetallic layers to electrically insulating oxide/nitride or oxy-nitride layers. This coating method could be applied to a commercial product. The liquid metal can be used over and over because only the solutes are consumed within the liquid metal. The technique can be applied to various shapes because the coating is formed by liquid-phase reaction. This paper will discuss initial results on the nature of the coatings and their in-situ electrical resistivity characteristics in liquid lithium at high temperatures.

23178 (ANL/TD/CP–81664) **Surface erosion issues and analysis for dissipative divertors.** Brooks, J.N. (Argonne National Lab., IL (United States)); Ruzic, D.N.; Hayden, D.B.; Turkot, R.B. Jr. Argonne National Lab., IL (United States). May 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940580–1: 11. international conference on plasma surface interactions in controlled fusion devices, Mito (Japan), 23-27 May 1994). Order Number DE94013443. Source: OSTI; NTIS; INIS; GPO Dep.

Erosion/redeposition is examined for the sidewall of a dissipative divertor using coupled impurity transport, charge exchange, and sputtering codes, applied to a plasma solution for the ITER design. A key issue for this regime is possible runaway self-sputtering, due to the effect of a low boundary density and nearly parallel field geometry on redeposition parameters. Net erosion rates, assuming finite self-sputtering, vary with wall location, boundary conditions, and plasma solution, and are roughly of the following order: 200–2000 Å/s for beryllium, 10–100 Å/s for vanadium, and 0.3–3 Å/s for tungsten.

23179 (ANL/TD/CP–81686) **Comprehensive model for disruption erosion in a reactor environment.** Hassanein, A. (Argonne National Lab., IL (United States)); Konkashbaev, I. Argonne National Lab., IL (United States). May 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940580–2: 11. international conference on plasma surface interactions in controlled fusion devices, Mito (Japan), 23-27 May 1994). Order Number DE94013422. Source: OSTI; NTIS; INIS; GPO Dep.

Disruptions in tokamak reactors are still of serious concern and present a potential obstacle for successful operation and reliable design. Erosion of plasma-facing materials due to thermal energy dump during a disruption can severely limit the lifetime of these components, therefore diminishes the economic feasibility of the reactor. A comprehensive disruption erosion model which takes into account the interplay of all physical processes during plasma-material interaction has been developed. The initial burst of energy delivered to facing-material surfaces from direct impact of plasma particles causes sudden ablation of these materials. As a result, a vapor cloud is formed in front of the incident plasma particles. Shortly thereafter, the plasma particles are stopped in the vapor cloud, heating and ionizing it. The energy transmitted to the material surfaces is then dominated by photon radiation. It is the dynamics and the evolution of this vapor cloud that finally determines the net erosion rate and, consequently, the component lifetime. The model integrates with sufficient detail and in a self-consistent way, material thermal evolution response, plasma-vapor interaction physics, vapor hydrodynamics and radiation transport in order to realistically simulate the effects of a plasma disruption on plasma-facing components. Candidate materials such as beryllium and carbon have.been analyzed. The dependence of the net erosion rate on disruption physics and various parameters was analyzed and is discussed.

23180 (ANL/TD/CP–82061) **Characterization of nuclear transmutations in materials irradiated test facilities.** Gomes, I.C.; Smith, D.L. Argonne National Lab., IL (United States). May 1994. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–9: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94013309. Source: OSTI; NTIS; INIS; GPO Dep.

This study presents a comparison of nuclear transmutation rates for candidate fusion first wall/blanket structural materials in available, fission test reactors with those produced in a typical fusion spectrum. The materials analyzed in this study include a vanadium alloy (V-4Cr-4Ti), a reduced activation martensitic steel (Fe-9Cr-2WVTa), a high conductivity copper alloy (Cu-Cr-Zr), and the SiC compound. The fission irradiation facilities considered include the EBR-II fast reactor, and two high flux mixed spectrum reactors, HFIR (High Flux Irradiation Reactor) and SM-3 (Russian reactor). The transmutation and dpa rates that occur in these test reactors are compared with the calculated transmutation and dpa rates characteristic of a D-T fusion first wall spectrum. In general, past work has shown that the displacement damage produced in these

fission reactors can be correlated to displacement damage in a fusion spectrum; however, the generation of helium and hydrogen through threshold reactions [(n,x,α) and (n,xp)] are much higher in a fusion spectrum. As shown in this study, the compositional changes for several candidate structural materials exposed to a fast fission reactor spectrum are very low, similar to those for a characteristic fusion spectrum. However, the relatively high thermalized spectrum of a mixed spectrum reactor produces transmutation rates quite different from the ones predicted for a fusion reactor, resulting in substantial differences in the final composition of several candidate alloys after relatively short irradiation time.

23181 (ANL/TD/CP–82439) **Status of beryllium development for fusion applications.** Billone, M.C. (Argonne National Lab., IL (United States)); Donne, M.D.; Macaulay-Newcombe, R.G. Argonne National Lab., IL (United States). May 1994. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–8: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94013424. Source: OSTI; NTIS; INIS; GPO Dep.

Beryllium is a leading candidate material for the neutron multiplier of tritium breeding blankets and the plasma facing component of first wall and divertor systems. Depending on the application, the fabrication methods proposed include hot-pressing, hot-isostatic-pressing, cold isostatic pressing/sintering, rotary electrode processing and plasma spraying. Product forms include blocks, tubes, pebbles, tiles and coatings. While, in general, beryllium is not a leading structural material candidate, its mechanical performance, as well its performance with regard to sputtering, heat transport, tritium retention/release, helium-induced swelling and chemical compatibility, is an important consideration in first-wall/blanket design. Differential expansion within the beryllium causes internal stresses which may result in cracking, thereby affecting the heat transport and barrier performance of the material. Overall deformation can result in loading of neighboring structural material. Thus, in assessing the performance of beryllium for fusion applications, it is important to have a good database in all of these performance areas, as well as a set of properties correlations and models for the purpose of interpolation/extrapolation.

23182 (ANL/TD/CP–82549) **Validation of the TIARA code to tritium inventory data.** Billone, M.C. Argonne National Lab., IL (United States). Mar 1994. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9406171–1: 3. international workshop on ceramic breeder blanket interactions, Los Angeles, CA (United States), 22-24 Jun 1994). Order Number DE94012449. Source: OSTI; NTIS; INIS; GPO Dep.

The TIARA code has been developed to predict tritium inventory in Li_2O breeder ceramic and to predict purge exit flow rate and composition. Inventory predictions are based on models for bulk diffusion, surface desorption, solubility and precipitation. Parameters for these models are determined from the results of laboratory annealing studies on unirradiated and irradiated Li_2O. Inventory data from in-reactor purge flow tests are used for model improvement, fine-tuning of model parameters and validation. In this current work, the inventory measurement near the purge inlet from the BEATRIX-II thin-ring sample is used to fine tune the surface desorption model parameters for T > 470°C, and the inventory measurement near the midplane from VOM-15H is used to fine tune the moisture solubility model parameters. predictions are then validated to the remaining inventory data from EXOTIC-2 (1 point), SIBELIUS (3 axial points), VOM-15H (2 axial points), CRITIC-1 (4 axial points), BEATRIX-II thin ring (3 axial points) and BEATRIX-II thick pellet (5 radial points). Thus. of the 20 data points, two we re used for fine tuning model parameters and 18 were used for validation. The inventory data span the range of 0.05–1.44 wppm with an average of 0.48 wppm. The data pertain to samples whose end-of-life temperatures were in the range of 490–1000°C. On the average, the TIARA predictions agree quite well with the data (< 0.02 wppm difference). However, the root-mean-square deviation is 0.44 wppm, mostly due to over-predictions for the SIBELIUS samples and the higher-temperature radial samples from the BEATRIX-11 thick-pellet.

23183 (ANL/TD/CP–82626) **Neutronics of a D-Li neutron source: An overview.** Gomes, I.C.; Smith, D.L. Argonne National Lab., IL (United States). May 1994. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940664–10: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94013403. Source: OSTI; NTIS; INIS; GPO Dep.

The importance of having a high energy (14 MeV) neutron source for fusion materials testing is widely recognized. The availability of a test volume with easy accessibility, with a radiation environment similar to the one expected for a fusion reactor, and with dimensions large enough to accommodate several small samples or a small blanket mock-up are requirements impossible to meet with the existing reactors and irradiation facilities. A D-Li neutron source meets the above mentioned requirements and can be built today with well known technology. This paper describes some relevant topics related to beam target configuration, neutron flux spectrum, and nuclear responses for a D-Li neutron source. The target-beam configuration is analyzed for different beam cross sectional areas and trade-offs between the area of the beam and related quantities such as available volume for testing, peak fluxes, and flux or nuclear responses gradient are presented. The conclusion is that the D-Li neutron source has the necessary characteristics to be the option of choice for IFMIF.

23184 (ANL/TD/CP–83032) **Erosion/redeposition analysis of the DIII-D divertor.** Hua, T.Q.; Brooks, J.N. Argonne National Lab., IL (United States). May 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940580–3: 11. international conference on plasma surface interactions in controlled fusion devices, Mito (Japan), 23-27 May 1994). Order Number DE94013402. Source: OSTI; NTIS; INIS; GPO Dep.

Carbon and tungsten sputtering and transport in the DIII-D divertor is analyzed with the impurity transport codes REDEP and WBC. Analysis is carried out for a recent DiMES experiment in which a carbon sample with a tungsten marker in the center was exposed to six well controlled ELM-free plasma discharges. WBC analysis predicts a high rate of ionization of tungsten neutrals within the sheath and subsequent redeposition on the DiMES sample. Qualitative comparison of the tungsten redeposited flux agrees well with measurements. REDEP analysis of net carbon erosion shows a factor of 2-3 agreement with measured data on the outboard side of DiMES and poor agreement on the inboard side.

23185 (CNIC–00737) **Study on heat flux of plasma scrape-off layer in HL-1 tokamak.** Li Guodong (Southwest Inst. of Physics, Leshan, SC (China)); Xu Yuanxian; Gong Xiaodong. China Nuclear Information Centre, Beijing, BJ (China). May 1993. 7p. (In Chinese). (SIP–0059.). Order Number DE94627009. Source: OSTI; NTIS (US Sales Only); INIS.

A study of the heat flux of plasma scrape-off layer (SOL) in HL-1 tokamak has been performed by a probe shielded with circular graphite tube. The radial distribution of heat flux was obtained in the ion-drift side and electron-drift side of the SOL. By using thermocouples, the heat load on the graphite tiles of pump limiter head and its non-homogeneous poloidal distribution have been measured. The heat load on the limiter head and on the neutralizer plate of diverter was significantly reduced owing to the puffing at the head of plate. Some performances of the plasma also were improved.

23186 (CNIC–00742) **Theoretical investigation of matching between plasma heating and fuelling in HL-1M machine.** Guo Shuyin (Qinghua Univ., Beijing, BJ (China). Inst. of Nuclear Energy Technology). China Nuclear Information Centre, Beijing, BJ (China). 1993. 11p. (In Chinese). (SIP–0061.). Order Number DE94627019. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to ohmic heating, the auxiliary heating such as ICR, ECR and LHR will be used in HL-1M machine. The pellet injection is considered as a possible method to increase the plasma density. The purpose of this article is to analyse matching problem between heating and fuelling. The condition under which the auxiliary heating is effective depends on the plasma density. The plasma density will be changing during pellet injection. The high plasma temperature resulting from the auxiliary heating affects the rate of pellet

ablation. There is an optimum choice for pellet size to match the plasma density and temperature. Finally, the permissible size and the injection frequency of the pellet are also given.

23187 (CNIC–00756) **Solid tritium materials for fusion reactor and its development.** Jiang Guoqiang (Institute of Materials and Technology, SC (China)). China Nuclear Information Centre, Beijing, BJ (China). Jun 1993. 15p. (In Chinese). (SMI–0007.). Order Number DE94627020. Source: OSTI; NTIS (US Sales Only); INIS.

The data related to properties of several solid tritium breeder materials, such as Li_2O, $LiAlO_2$, Li_2SiO_3, Li_4SiO_4 and Li_2ZrO_3, are collected. The criterion of selecting breeder materials for fusion reactor is discussed. After comparing these data the review on the development trend of these materials in the future is presented.

23188 (CONF-920717–6) **Loading characterization of the modified TFTR ICRF antennas.** Rogers, J.H. (Princeton Plasma Physics Lab., NJ (United States)); Wilson, J.R.; Stevens, J.; Hosea, J.C.; Schilling, G.; Phillips, C.K.; Hoffman, D.J.; Rasmussen, D. Oak Ridge National Lab., TN (United States); Princeton Univ., NJ (United States). Plasma Physics Lab. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ; AC02-76CH03073. From Topical conference meeting on radio frequency heating and current drive of fusion devices; Brussels (Belgium); 7-10 Jul 1992. Order Number DE94013254. Source: OSTI; NTIS; INIS; GPO Dep.

Previous ICRF experiments on TFTR utilized two RF antennas of different design, and differences in antenna loading impedance values were observed. In order to ascertain whether it was these design features or the local geometry causing the loading differences, one of the antennas was modified to closely resemble the other. Changes made to the antenna include the Faraday shield geometry, the protective tile geometry, and slitting of the antenna side walls and septum. Remaining differences include the toroidal separation of the antenna straps leading to different $k_{||}$ spectrums for the two antennas and the closer proximity of one antenna to a limiter than the other. This latter difference may result in different plasma density profiles at each antenna face. Experimental results indicate that the design features did account for some differences in the antenna loading values previously observed. The modified antenna achieved a power of 3.5 MW with an antenna voltage of 50 kV. The differences in the antenna loading values which remain are attributed to the differences in the $k_{||}$ spectrum.

23189 (DOE/ER/52147–7) **Microwave generation for magnetic fusion energy applications: Task A, Free electron lasers with small period wigglers; Task B, Theory and modeling of high frequency, high power gyrotron operation: Progress report, May 1, 1993–May 1, 1994.** Antonsen, T.M. Jr.; Destler, W.W.; Granatstein, V.; Levush, B. Maryland Univ., College Park, MD (United States). May 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER52147. Order Number DE94012107. Source: OSTI; NTIS; INIS; GPO Dep.

This task involves the feasibility of high-power pulsed, high-efficiency, millimeter-wave free electron lasers (FEL) for ecr of thermonuclear plasmas. The research undertaken is to develop high average power FEL at voltage below IMV allowing for smaller and less costly power supplies. Linear amplification experiments employing a No. 56 period untapered wiggler have been conducted, and substantial small signal gain was observed at 95 GHz over a wide range of experimental conditions consistent with the prediction of one-dimensional numerical simulation. Progress is also reported on theoretical studies relating to the development of high-power gryotron and the ability to predict and improve the performance of various cavity designs.

23190 (DOE/ER/54185–T1) **Initial studies of reflectometer for ITER: Final report.** Luhmann, N.C. Jr. California Univ., Davis, CA (United States). Dec 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-92ER54185. Order Number DE94012476. Source: OSTI; NTIS; INIS; GPO Dep.

ITER-related activities taking place over the last year were concentrated primarily on the area of advanced reflectometry systems. In particular, we have concentrated on reflectometer systems for density profile and density fluctuation studies on ITER. This interest has led us to spend much of our time investigating the pulsed radar time-of-flight reflectometer approaches (i.e. moderate pulse and ultrashort pulse). Pulsed radar systems offer the ability to make detailed profile measurements using fixed frequency sources, avoiding the need for highly stable sweepable sources as required by the more traditional FM radar systems.

23191 (DOE/FTR–94006025) **Meetings on the status of ICF Research Programs and Conceptual ICF Reactor Studies: Foreign trip report, October 14–22, 1993.** Quintenz, J.P.; Olson, C.L.; Lockner, T.R. Sandia National Labs., Albuquerque, NM (United States). 24 Jan 1994. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94006025. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The workshop on the Status of ICF Research Programs and Conceptual ICF Reactor Studies was held at Kernforschungszentrum Karlsruhe (KfK) on October 18–20, 1993. The workshop consisted of three full days of invited talks on light ion fusion, heavy ion fusion, and laser fusion. Total attendance was about 80 people (see attached participants list). The day after the meeting we spent in technical discussions on light ion fusion wit the staff at KfK. In addition a major fusion exhibit -Fusion Expo 93- opened at KfK on the first day of the meeting.

23192 (DOE/FTR–94006182) **Travel to Japan to collaborate on the study of the first wall of JT-60 Upgrade: Foreign trip report, November 26–December 13, 1993.** Mills, B.E. Sandia National Labs., Albuquerque, NM (United States). 13 Jan 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. m. Order Number DE94006182. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This trip coincided with a major vent of JT-60U, Japan's largest fusion device. The beta backscatter technique has been developed over the years in work on TMX, TFTR, DIII-D, JET, and TEXTOR. It has been applied to the measurement of the deposition and erosion areas, particularly the high heat flux areas. In 1992 we were able to study the entire divertor and several complete poloidal sections of the first wall. During this vent the Japanese collaborators removed sections of the divertor and first wall for measurement within the controlled area around the torus. A preliminary comparison of the current investigation with the previous measurements of the divertor is attached. Also included is an assessment of the efficacy of the JT-60 experience with in situ boronization using decaborane and their experience with carbon composite tiles with B_4C conversion coated surfaces.

23193 (DOE/FTR–94007129) **The US and Japanese collaboration on the ITER CD Model Coil: Foreign trip report, January 11–22, 1994.** Montgomery, D.B. Massachusetts Inst. of Tech., Cambridge, MA (United States). 22 Feb 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-93ER54186. Order Number DE94007129. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The US and Japanese teams held their first joint meeting January 20th in Naka to discuss the details of their collaboration on the ITER CS Model Coal. The US will build the high-field module and supporting structure, and the Japanese the mid-field module and the test insert. The meeting was attended by general Dynamics and Westinghouse, the US industrial contractors for the model coil, and by representatives of the three firms who will compete to be the Japanese industrial contractor. Details of the overall design, the detailed hardware and interface responsibilities, and electronic communications were agreed. The two parties will write a single common response to the Joint Central Team outlining the details of their collaboration and credit sharing by February 15th.

23194 (DOE/FTR–94008073) **Meetings in Japan on the International Thermonuclear Experimental Reactor (ITER) Project: Foreign trip report, February 11–22, 1994.** Piet, S.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1994]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE94008073. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Mr. Piet traveled to Naka to participate in the International Thermonuclear Experimental reactor (ITER) Magnet Design and Safety Workshop which is part of the ITER Engineering Design Activity.

23195 (DOE/FTR–94008074) **Discussion of Loss of Vacuum Accident (LOVA) testing and Ingress of Coolant Event (ICE) testing: Foreign trip report February 15–22, 1994.** Petti, D.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1994]. 199p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE94008074. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary purpose was to attend a technical workshop concerning collaboration on thermal hydraulic testing under the auspices of the International Energy Agency (IEA) agreement on the Environment, Safety, and Economics of fusion. The traveler also attended informal meetings related to the International Thermonuclear Experimental Reactor (ITER) project. The agenda for the IEA workshop and copies of all presentations are attached. The purpose of the meeting from 2/16 – 2/18 was to discuss the potential for collaboration on thermal hydraulic testing being performed in Japan. Two specific experiments were discussed: (a) Loss of Vacuum Accident (LOVA) testing and (b) Ingress of coolant Event (ICE) testing. Collaboration possibilities include: (a) joint experiments (both operation and data acquisition), (b) joint measurements (others bring instrumentation for use in the experiment) and (c) joint safety computer code development.

23196 (DOE/FTR–94009141) **Travel to Italy for the Fifth International Workshop on Tritium: Foreign trip report, March 4–10, 1994.** Longhurst, G.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). 12 Mar 1994. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE94009141. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Mr. Longhurst traveled to Ispra to attend a meting for the organization of the Fifth International workshop on Tritium which will be held at Belqirate, Italy, May 28 through June 3, 1995. He then traveled to Germany, to attend a second meeting at Kernforschungszentrum (KfK), Karlsruhe, Germany, to discuss further details of the proposed 1995 Workshop on Beryllium Technology for fusion which will be held at Jackson, Wyoming in September 1995.

23197 (DOE/FTR–94009530) **Trip report for visit to the Naka Joint work site: Foreign trip report, February 14–28, 1994.** Cadwallader, L. EG and G Idaho, Inc., Idaho Falls, ID (United States). 4 Mar 1994. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE94009530. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler met with Dr. D. Holland of the International Thermonuclear Experimental Reactor (ITER) Joint Central Team and assisted in developing failure modes and effects data for ITER magnets. He also participated in the ITER Magnet Safety Technical meeting.

23198 (DOE/SF/19201–T1) **Fusion with highly spin polarized HD and D_2: Final report, January 2, 1992–June 30, 1993.** Honig, A. (Syracuse Univ., NY (United States). Dept. of Physics); Letzring, S.; Skupsky, S. Rochester Univ., NY (United States). Lab. for Laser Energetics. 17 Dec 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-92SF19201. Order Number DE94010243. Source: OSTI; NTIS; INIS; GPO Dep.

Our experimental efforts over the past 5 years have been aimed at cazrying out ICF shots with spin-polarized 0 fuel. We successfully prepared polarized 0 in HD, and solved the problems of loading target shells with our carefully prepared isotopic -mixt.l.l?-es, polarizing them so that the 0 polarization remains metastably frozen-in for about half a day, and carrying out the various cold transfer requirements at Syracuse, where the target is prepared, and at Rochester, where the cold target is inserted fusion chamber. Upon shooting the accurately positioned unpolarized high density cold target, no neutron yield was observed. Inspection inside the OMEGA tank after the shot indicated the absence of neutron yield was dus to mal-timing or insufficient retraction rate of OMEGA'S fast shroud mechanism, resulting in interception of at least 20 of the 24 laser beams by the faulty shroud. In spits of this, all alements of the complex experiment we originally undertook have been successfully demonstrated, and the cold retrieval concepts and methods we developed are being utilized on the ICF upgrades at Rochester and at Livermore. In addition to the solution of the interface problems, we obtained novel results on polymer shell characteristics at low temperatures, and continuation of these experiments is c = ently supported by KLUP. Extensive additional mappings were ca=ied out of nuclear spin relaxation rates of H and D in solid HD in the temperature-magnetic field rangs of 0.01 to 4.2K and 0 - 13 Tesla. New phenomena were discovered, such as association of impurity clustering with very low temperature motion, and inequality of the growth-rate and decay-rate of the magnetization.

23199 (ENEA-RT-INN–93-12) **Nuclear testing of $LiAlO_2$ and Li_2ZrO_3 ceramic breeder materials.** Alvani, C. (ENEA, Casaccia (Italy). Area Energia e Innovazione); Carconi, P.L.; Casadio, S.; Cosoli, G.; De Luca, A.; Filacchioni, G.; Mancini, M.R.; Moauro, A. ENEA, Casaccia (Italy). Area Energia e Innovazione. Nov 1993. 15p. (RT/INN–93-12). Order Number DE94775302. Source: OSTI; NTIS (US Sales Only).

The rate of tritium release from Li-ceramics, measured by in-situ and out of pile tests, is reported. The data are related to the nature ($LiAlO_2$ vs. Li_2ZrO_3) and the microstructure of the materials, as well as, to the helium purging gas composition (hydrogen vs. water-hydrogen mixtures). Moreover, the situation is reported about the fission neutron radiation damage on $LiAlO_2$ ceramic breeder materials under development at ENEA (Italian Agency for Energy, New Technologies and the Environment) for the DEMO relevant Helium Cooled Solid Blanket.

23200 (ETDE/IT-mf–94775341) **Evaluation of aluminium MMC as possible structural material in future nuclear fusion reactors.** Donato, A. (ENEA, Frascati (Italy). Area Nucleare); Pierazzi, L. ENEA, Frascati (Italy). Area Nucleare. 1993. 4p. Order Number DE94775341. Source: OSTI; NTIS (US Sales Only).

In this paper, a technical evaluation of an aluminium-20% SiC composite as a possible structural material in future nuclear fusion reactors is reported. The main issues concerning the properties directly affecting its behaviour from the nuclear point of view are taken into account. Neutron-induced radioactivity, environmental impact, nuclear transmutation characteristics, decay heat, and helium and hydrogen production are evaluated.

23201 (GA-A–21657) **Fusion research at General Atomics: Annual report, October 1, 1992–September 30, 1993. General Atomics Project 3469.** General Atomics, San Diego, CA (United States). May 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER52153. Order Number DE94012406. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the General Atomics Fusion Physics annual report for the period October 1992 thru September 1993. It highlights major activities and projects in four areas: fusion technology development overview; reactor design studies; RF technology; plasma facing components. A listing of publications for the period is also enclosed.

23202 (INIS-mf–14193) **Nuclear fusion. Research and development.** Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

11 papers clearly and exhaustively deal with the foundations and state-of-the-art of fusion reactors. (HP)

23203 (INIS-mf–14193, pp. 4-6) **Physical fundamentals of nuclear fusion.** Maurer, W. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication THERMONUCLEAR REACTORS/ thermonuclear reactions; THERMONUCLEAR FUELS/tritium; LITHIUM 6; LITHIUM 7; TRITIUM

23204 (INIS-mf–14193, pp. 7-15) **Plasma physical fundamentals of fusion reactors.** Klingelhoefer, R.; Maurer, W. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

The plasma physical objective of a DT fusion reactor consists in producing a self-sustained DT mixture. This includes plasma confinement, generation of the plasma burning temperature, and fuel reloading. The level of plasma physical development is explained

by means of the asdex tokamak, JET, stellarator, and divertor. (DG)

23205 (INIS-mf–14193, pp. 16-20) **The way towards fusion reactors.** Maurer, W.; Klingelhoefer, R. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

The way towards construction of a fusion reactor is illustrated giving as an example the current design of NET/ITER. The structure of the DT fusion reactor, typical parameters as well as operational modes of the tokamak reactor, and its energy balance are graphically described. (DG)

23206 (INIS-mf–14193, pp. 21-30) **The closed fuel cycle.** Ache, H.J.; Penzhorn, R.D. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

The safe and economical continuous operation and waste minimization of a fusion reactor require the recovery of the evacuated, unspent fuel. The waste gas effluents to be coped with are discussed on the basis of different operating modes of the tokamak, and subsequently the configuration of the pumping system, gas purification, isotope separation, and the blanket waste gas system are described giving as an example the NET/ITER project. Finally a tritium laboratory is described. (DG)

23207 (INIS-mf–14193, pp. 31-43) **First wall and divertor.** Dienst, W.; Ehrlich, K.; Kleefeldt, K.; Schinke, D. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

In a fusion reactor interactions are produced by particles and radiation, between the plasma and the first wall surrounding it. The applicable metallic and non-metallic materials must be suited to stand the neutron and heat radiation, and thermal shocks. Their chemical compatibility, in particular in the event of incidents, and their properties with regard to tritium uptake and release are decisive. The technical design of the first wall and the divertor is explained on the basis of the NET/ITER project. (DG)

23208 (INIS-mf–14193, pp. 44-50) **The breeding blanket.** Kuechle, M. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

The breeding blanket surrounds the plasma, converts the kinetic energy of the neutrons into heat, and replaces the T consumed in DT reactions. Because of the problems and insecurities inherent in all blanket concepts, worldwide about eight different blanket types are being developed parallely. The most promising type shall be used in the NET/ITER. (DG)

23209 (INIS-mf–14193, pp. 51-56) **Remote handling technique.** Boehme, G.; Suppan, A. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

Economical operation of a fusion reactor requires intensive maintenance. For this purpose and due to the special conditions with regard to the components of a fusion reactor, remote handling instruments and machinery have to be developed. The state-of-the-art of such remote handling technique, in particular of multi-purpose and special devices (master-slave-manipulators), is described. (DG)

23210 (INIS-mf–14193, pp. 57-65) **Superconducting magnets for nuclear fusion.** Maurer, W. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

Superconducting magnet systems are necessary for a fusion power plant in order to guarantee a positive energy blance. The development level of such superconducting magnets for nuclear fusion is described in short. (DG)

23211 (INIS-mf–14193, pp. 66-69) **Electron-cyclotron resonance heating.** Kuntze, M.; Thumm, M. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

Plasma heating has proved to be a promising heating method for a fusion reactor. The high-performance gyrotron within the reactor-relevant frequency range of about 140 GHz developed by the KfK has been made available for use in the stellarator experiment Wendelstein VII-AS. By it heat wave experiments are performed to determine the thermal conductivity of electrons in high-density plasmas heated up by inclusion of high-energy neutral particles. (DG)

23212 (INIS-mf–14193, pp. 70-76) **Safety and environmental impacts.** Fiege, A.; Kramer, W. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

By means of interpreting experimental results, and by means of conservative estimates, several fundamental statements can be made concerning the safety and environmental impacts of fusion plants. Relevant findings so far regarding normal operation and incidents as well as risks involved in raw material extraction and waste management are compiled. (DG)

23213 (INIS-mf–14193, pp. 77-80) **The development of fusion research on an international scale.** Vetter, J.E. Kernforschungszentrum Karlsruhe GmbH (Germany). 1991. 83p. (In German). In *Nuclear fusion. Research and development.* Order Number DE94773790. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication THERMONUCLEAR REACTORS/research programs; THERMONUCLEAR DEVICES/international cooperation

23214 (INS–1015) **Accelerators for energy production.** Katayama, Takeshi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1993. 7p. Order Number DE94770764. Source: OSTI; NTIS; INIS.

A tremendous progress of accelerators for these several decades, has been motivated mainly by the research on subnuclear physics. The culmination in high energy accelerators might be SSC, 20 TeV collider in USA, probably the ultimate accelerator being built with the conventional principle. The technology cultivated and integrated for the accelerator development, can now stably offer the high power beam which could be used for the energy problems. The Inertial Confinement Fusion (ICF) with high current, 10 kA and short pulse, 20 ns heavy ion beam (HIB) of mass number $\approx$200, would be the most promising application of accelerators for energy production. In this scenario, the fuel containing D-T mixture, will be compressed to the high temperature, $\approx$10 keV and to the high density state, $\approx$1000 times the solid density with the pressure of ablative plasma or thermal X ray produced by bombarding of high power HIB. The efficiency, beam power/electric power for accelerator, and the repetition rate of HIB accelerators could be most suitable for the energy production. In the present paper, the outline of HIB ICF (HIF) is presented emphasizing the key issues of high current heavy ion accelerator system. (author).

23215 (IPP–III/186(v.2), pp. 423-444) **Millimetre wave systems for high-power ECRH, status and future trends.** Kasparek, W. (Inst. fuer Plasmaforschung, Stuttgart Univ. (Germany)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Electron cyclotron resonance heating (ECRH) and electron cyclotron current drive (ECCD) are of growing importance among the heating and current drive methods for fusion plasmas. To get full advantage of the two main features of this technique, namely the absence of antenna structures near the plasma boundary and the possibility of localized power deposition, the launching of a well collimated beam with a controlled direction and polarization is necessary. This requires the transmission of the high-power millimetre waves with high mode purity. The first part of the paper reviews

the results achieved up to now with transmission of TE_{0n} modes at a typical power level of 200 kW in the frequency range below 100 GHz and the subsequent transformation of these modes to the HE_{11}-mode, which produces a beam with defined polarization and high directivity at the antenna. Influenced by the need of higher power (≥500 KW per generator) and higher frequencies (≥100 GHz), two other transmission schemes are now under development and partly already in use, namely highly overmoded, circumferentially corrugated or dielectrically lined circular HE_{11}-mode waveguides and quasi-optical beam waveguides using focusing reflectors for transmission of the TEM_{00}-mode. These methods are well adapated to the high-power sources available or in development (gyrotrons with built-in mode converter, quasi-optical gyrotrons, cyclotron auto-resonance masers and free-electron lasers), as these sources emit a gaussian beam and thus no further mode conversion is necessary. The main part of this paper will discuss the components and the characteristics of HE_{11}- and TEM_{00} transmission systems and antennas. The advantages and disadvantages are highlighted and a comparison is performed. Examples of ECRH systems using these techniques are described.

23216 (IPP–III/186(v.2), pp. 445-480) **Recent results from the 60 GHz inside launch ECH system on the DIII-D tokamak.** Luce, T.C. (General Atomics, San Diego, CA (United States)); Petty, C.C.; Prater, R.; Harvey, R.W.; James, R.A.; Lin-Liu, Y.R.; Lohr, J. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. Contract DE-AC03-89ER51114; Contract W-7405-ENG-48. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Electron cyclotron heating (ECH) is a useful tool in global transport and local confinement studies. Operational experience with the inside launch ECH system on DIII-D shows that reliable operations are possible with power densities up to 0.7 GW/m^2 in vacuum waveguide. Global confinement is roughly predicted by the Rebut-Lallia or ITER-89P scaling law, but direct analysis indicates a nearly linear scaling with toroidal field not found in these scaling laws. Local transport studies with off-axis heating clearly show inward transport in the electron fluid. This implies that diffusive and critical gradient models cannot completely describe plasma transport. (orig.)

23217 (IPP–III/186(v.2), pp. 523-530) **The 110 GHz electron cyclotron heating and current drive system of Tore Supra.** Pain, M. (Association CEA-EURATOM sur la Fusion, Centre d'Etudes Nucleaires de Cadarache, 13 - St. Paul-lez-Durance (France)); Berger-By, G.; Capitain, J.J. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Tore Supra is a super conducting toroidal field coils tokamak, allowing to conduct a research program oriented towards very long pulses, with goals of 210 seconds length and above. A 110 GHz electron cyclotron heating and current drive system is now being designed on Tore Supra, in order to study its potential as a current drive system on a future reactor, and more particularly its synergy with lower hybrid current drive. Although the sources required to generate large amounts of power (3 MW in our case) are still under development, the simplicity of the antenna is still very attractive from the point of view of the installation in a reactor environment, where in-torus components are difficult to maintain. The Tore Supra ECRHCD system will consist of six gyrotrons expected to generate about 500 kW each under the TE_{64} mode. The gyrotrons will be fitted with cryogenic windows to allow the tubes to operate in a quasi-CW regime (pulse length 210 seconds). The transmission line will be a circular corrugated waveguide propagating the HE_{11} mode. This mode has been selected because its low losses and good polarisation properties. A mode conversion chain will therefore be required between the gyrotron output and the transmission line. The antenna will have the capability of aiming at any point inside the plasma in the poloidal plane and to launch the beams with an angle in the toroidal plane up to 30 . (orig.)

23218 (IPP–III/186(v.2), pp. 531-537) **Plans for improvements to the ATF ECH system.** Bigelow, T.S. (Oak Ridge National Lab., TN (United States)); Goldfinger, R.C.; Murakami, M.; Schaich, C.R.; Wilgen, J.B. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. Contract DE-AC05-84OR21400. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

The Advanced Toroidal Facility (ATF) stellarator experiment at Oak Ridge National Laboratory (ORNL) uses electron cyclotron waves for plasma formation and heating. Although the existing systems are quite reliable and produce acceptable plasmas, a few deficiencies should be corrected. Therefore, several possible upgrades to the electron cyclotron heating (ECH) systems have been planned. Some of the desirable changes are (1) improving the launcher to make power deposition in the plasma more centralized, (2) improving the gyrotron power waveform monitoring diagnostics, (3) building a high-field launch system for higher density operation at 53-GHz (4) building a separate transmission line for the 35-GHz gyrotron, and (5) installing a higher frequency, higher power (84- or 110-GHz) gyrotron system for improved plasma density and temperature capability. This paper discusses options for these improvements and conceptual designs. (orig.)

23219 (IPP–III/186(v.2), pp. 539-548) **A 500 kW, 140 GHz gyrotron in an asymmetric volume mode for fusion plasma applications.** Borie, E. (Kernforschungszentrum Karlsruhe, ITP (Germany)); Gantenbein, G.; Dammertz, G.; Dumbrajs, O.; Geist, T.; Kuntze, M.; Moebius, A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

A major goal of the KfK gyrotron development program is the design and construction of a high power, long pulse 140 GHz gyrotron for electron cyclotron wave applications in fusion research. As a first step a $TE_{0,3}$ tube with a pulse length of 400 ms and an output power of up to 120 kW was constructed, tested, and successfully used for plasma heating and plasma diagnostics of neutral beam sustained, high density plasmas in the W7AS stellarator at IPP in Garching. These results have been reported elsewhere and will not be discussed further here. To reach higher power at increased pulse length a higher order cavity mode must be chosen. As a next step, KfK has designed, built, and is testing a gyrotron which operates in the $TE_{10,4}$ mode with an output power of up to 690 kW, and frequency 140 GHz. The RF power is coupled out with an axial window. This phase of the program aims to demonstrate the capabilities of the asymmetric volume mode (AVM) approach in generating high power levels. The next version, using a new magnet will use a built in quasi-optical mode transducing antenna which converts the rotating $TE_{10,4}$ mode to a free space Gaussian beam, and a radial window, in order to separate the mm-wave output and the electron beam. The influence of the quasi-optical convertor on the beam-field interaction in the resonator and the behavior of the convertor and mirror system under hot test conditions will be investigated. It may then be possible to extend the pulse length up to about 1/3 s (depending on the design of the window and collector). (orig.)

23220 (IPP–III/186(v.2), pp. 561-573) **R and D of transmission lines for high power millimeter waves.** Ohkubo, K. (National Inst. for Fusion Science, Nagoya (Japan)); Hosokawa, M.; Kubo, S.; Sato, M.; Takita, Y.; Kuroda, T. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In

Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2. Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

The performance of oversized transmission elements for millimeter waves is measured and compared with the calculation which is based on the superposition of plane wave (SPW) and on Fresnel approximation in the Huygens-Kirchhoff integral. Modeconversion in the split waveguide is discussed from the viewpoint of on- and off-axes and 90-degrees elbow bend on phase correction is examined by using the SPW method. The design and experiment on the whispering gallery mode generator are described. A preliminary analysis of the rectangular waveguide with two corrugated plates and two plane walls is also carried out to obtain the Gaussian beam with a waist size of x-axis different from that of y-axis. (orig.)

23221 (IPP–III/186(v.2), pp. 575-585) **Eigenmode mixtures in circumferentially corrugated waveguides.** Wagner, D. (Inst. fuer Plasmaforschung, Stuttgart Univ. (Germany)); Pretterebner, J.; Thumm, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Using a scattering matrix code the relative TE/TM eigenmode contents of hybrid modes in oversized circumferentially corrugated circular waveguides (ka=20-130 where $k=2\pi/\lambda$ is the free-space propagation constant and a is the inner waveguide radius) have been calculated. This computational technique includes all geometrical parameters of the corrugation profile and does not require any restrictions. The influence of slot depth and corrugation period on the eigenmode mixture have been examined. Since the H_z-field of the TE_{11} mode is nearly zero, the lowest order hybrid HE_{11} mode can be described in a good approximation by a two-mode TE_{11}/TM_{11} eigenmode combination whereas higher order hybrid modes contain several eigenmodes of the smooth-wall waveguide. For example, the $EH_{15,2}$ mode at 140 GHz in a corrugated waveguide with an inner diameter I.D.=27.79 mm and resonant slots (depth=λ/4, period p=λ/3) can be synthesized on the average by the following eigenmode mixture: $TE_{15,2}$ (55% power, 0 phase), $TM_{15,1}$ (26%, 180), $TE_{15,1}$ (10%, 180), $TM_{15,2}$ (7%, 0), $TE_{15,3}$ (1%, 0), $TM_{15,3}$ (0.5%, 0). (orig.)

23222 (IPP–III/186(v.2), pp. 587-606) **Speeding-up of the numerical analysis for millimetre wave aperture antennae.** Winning, P.R. (Dept. of Electronics, Kyoto Univ. (Japan)); Nakajima, M. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

By use of the geometrical theory of optics the radiation characteristics of a WGM antenna has already been investigated and designed. In order to improve the accuracy of the present calculation it was necessary to account for diffraction. This paper presents a numerical analysis techniques which have been developed to reduce the computational time and memory required to perform such a calculation. (orig.)

23223 (IPP–III/186(v.2), pp. 607-621) **Power combiners for incoherent waves.** Smits, F.M.A. (Association EURATOM-CEA sur la Fusion, DRFC/STIF CEA-Cadarache, 13 - Saint Paul-lez-Durance (France)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Mar 1993. 324p. (CONF-9210462–: 8. joint workshop on electron cyclotron emission and electron cyclotron resonance heating, Ising (Germany), 19-21 Oct 1992). In *Proceedings of eighth joint workshop on electron cyclotron emission and electron cyclotron resonance heating. Vol. 2.* Order Number DE94773565. Source: OSTI; NTIS (US Sales Only); INIS.

Far and near future ECH applications need an increasing amount of injected power. The total power demand goes far beyond the power capacity of a single source. Usually, the power of every source is transported independently to the torus. This leads to complicated transmission and launching systems which are expensive and occupy a large amount of valuable torus-port space. Since the power capacity of the transmission lines is often much larger than the source power, it would be advantageous to combine the power of several sources into a single transmission line. Besides the reduction of the required antenna space and suppression of a large number of transmission lines, one can reduce the number of wave polarisers which are required in case of oblique launch. This can be achieved if the combined waves have the same polarisation. As a whole it may infer an important cost reduction. (orig.)

23224 (JAERI-M–93-176) **High-flux deuterium plasma exposure tests of actively-cooled divertor plate units in PISCES-B.** Tanaka, Shigeru (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Araki, Masanori; Nakamura, Kazuyuki; Seki, Masahiro; Hirooka, Yoshihiko; Khandagle, M. Japan Atomic Energy Research Inst., Tokyo (Japan). Sep 1993. 22p. Order Number DE94770647. Source: OSTI; NTIS; INIS.

An actively-cooled divertor plate mock-up with three kinds of carbon-based armor tiles (IG430U, MFC-1, and CX2002U) designed and fabricated by JAERI was bombarded with steady-state and high-flux deuterium plasmas produced in UCLA PISCES-B. The plasma densities, electron temperatures, and ion fluxes were measured from 1 to 3×10^{19} m^{-3}, from 4 to 12 eV, and from 1.2 to 2.1×10^{23} ions/m^2s, respectively. The total ion fluence was of the order of 10^{26} ions/m^2. Interesting surface morphologies have been observed for the plasma-bombarded surfaces, having relatively large agglomerated carbon particles with diameters up to 100 micrometer. The plasma heat flux was measured with a calorimeter embedded in a graphite (IG430U) to range from 1.1 to 4.4 MW/m^2, which is in good agreement with the calculated value with a simple sheath theory. (author).

23225 (JAERI-M–93-208) **Comparison between a steady-state fusion reactor and an inductively driven pulse reactor: Study as a power plant.** Horiike, Hiroshi (Osaka Univ., Suita (Japan)); Kuroda, Toshimasa; Murakami, Yoshiki; Sugihara, Masayoshi; Matsuda, Shinzaburo. Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1993. 37p. Order Number DE94770682. Source: OSTI; NTIS; INIS.

In the present report, a comparison is made between tokamak reactors of steady state operation -SSTR- and pulse operation. The former design uses neutral beams as a current driver to realize steady state operation. The latter is inductively operated basic tokamak with burn time of one hour to a half day. This time is determined by dimensions of the central solenoid coil and these dimensions also determine the basic design concept of the pulse tokamak. The dimension includes effect of fatigue due to pulse operation. Performance as a power plant is evaluated with a schematic design of heat transport and power generation system. Heat accumulation in the primary coolant loop is studied in order to make up for a dwell time of a pulse reactor. It is shown that large heat accumulator is necessary to suppress a drop in output during the dwell time. The dwell time has an optimum length with respect to the dwell time. Comparison of fusion plant with other energy source reveals that reduction of the size is essential in order that the fusion is competitive with other sources. (author).

23226 (JAERI-M–93-214) **Development of an amorphous surge blocker for a high voltage acceleration power supply of the neutral beam injectors.** Mizuno, Makoto (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Ohara, Yoshihiro; Watanabe, Kazuhiro; Ozaki, Akira. Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1993. 18p. Order Number DE94770648. Source: OSTI; NTIS; INIS.

An amorphous surge blocker for a high voltage acceleration power supply for the neutral beam injectors has been developed. Since the saturation magnetic flux density of the amorphous core is higher than that of the ferrite core, the surge blocker made of amorphous cores can be reduced in size appreciably compared to the conventional ferrite surge blocker. A 350 kV, 0.05 volt-second amorphous surge blocker was designed, fabricated and tested. The amorphous core was made by winding an amorphous tape with a film for the layer insulation and was heat-treated to recover the

magnetic characteristics. The core is molded by epoxy resin and installed in a FRP insulator tube filled with SF_6 gas for the insulation. The volt-second measured was higher than the designed value and the electrical breakdown along the cores and between layers was not observed. This test result shows that the amorphous surge blocker is applicable for a dc acceleration power supply for high energy neutral beam injectors. (author).

23227 (JAERI-M–93-216) **Activation analysis for JT-60U experiments with deuterium gases.** Miya, Naoyuki (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1993. 76p. (In Japanese). Order Number DE94770681. Source: OSTI; NTIS; INIS.

Identification of radionuclides and evaluation of dose rate level have been made on the structural materials of the JT-60U tokamak device. A one-dimensional neutron and gamma-ray transport code ANISN and an induced activation calculation code CINAC are used in this work. Radionuclides of ^{56}Mn (High-Mn steel toroidal field coil case), ^{58}Co (Inconel-625 vessel) and ^{60}Co (SS-316 first wall supporting material) appeared on the structures, which contribute to the dose rate around a vacuum vessel. Cobalt-58 and ^{60}Co with long half-life time intensely make residual activation in the time of 3 days to 3 months corresponding to the maintenance time after shutdown. The calculated dose rate on the vessel agreed well with the measured data in the first 2 years D-D operations. The one-dimensional code provided a sufficient prediction for the dose rate, although an error due to the toroidal field coil modeling in the calculation is estimated within ≈30%. (author).

23228 (JAERI-M–93-249) **Evaluation of in-situ coated boron film in JT-60U: Portable sample stage system and its application to evaluate the coated boron film.** Yagyu, Junichi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Arai, Takashi; Ogiwara, Norio; Saidoh, Masahiro; Koike, Tsuneyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1994. 49p. (In Japanese). Order Number DE94770781. Source: OSTI; NTIS; INIS.

In JT-60 Upgrade (JT-60U), in-situ boron coating of the first wall (boronization) using decarborane has been performed in order to reduce plasma impurities. The evaluation of the properties of the coated boron film produced by boronization, such as the film thickness and its uniformity along the toroidal direction and the atomic composition in the film including hydrogen concentration has been carried out. For this purpose two sets of portable sample stage system, by which probe sample can be inserted into the same level as the first wall surface, have been made and attached to the upper ports of the JT-60U vacuum vessel which are toroidally separated by 180 degrees each other. The present report describes the newly-developed portable sample stage system, its application to JT-60U boronization session and the evaluation results of the properties of the coated boron film. (author).

23229 (KFK–5283) **Lifetime predicition for the first wall of a fusion machine: IAEA co-ordinated research programme. Second interim report: Behaviour of first wall components under thermal fatigue-stress analysis and life assessment.** Diegele, E.; Munz, D.; Schweinfurther, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Jan 1994. 64p. Order Number DE94773754. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the benchmark calculations for a First Wall component tested in the JRC-Ispra high heat flux test facility are presented. Results of thermal, elastic, elasto-plasitc analysis and lifetime assessment based on code rules and inelastic analysis are included. (orig./HP)

23230 (KFK–5288) **Nuclear fusion project. Annual report of the Association KfK/EURATOM. October 1992 - September 1993.** Kast, G. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Dec 1993. 162p. (EUR–15466-EN). Order Number DE94773755. Source: OSTI; NTIS (US Sales Only); INIS.

The central areas of work are: (1) Structural materials, plasma forming components, plasma engineering; (2) superconducting magnets; (3) vacuum systems; (4) basic blanket; (5) remote handling and maintenance; (6) safety and environment; (7) material development, mechanical properties of pre- and post-irradiation of MANET (steel 1.4914); (8) solid breeder and liquid metal test blankets; (9) ECRH power sources; (10) TRT-1=tritium supply and management; (11) study contracts for ITER/NET. (HP)

23231 (LA-UR–94-1739) **Inertial Electrostatic Confinement (IEC) devices.** Nebel, R.A. (Los Alamos National Lab., NM (United States)); Turner, L.; Tiouririne, T.N.; Barnes, D.C.; Nystrom, W.D.; Bussard, R.W.; Miley, G.H.; Javedani, J.; Yamamoto, Y. Los Alamos National Lab., NM (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940216–4: Nondestructive assay and nondestructive examination waste chracterization conference, Pocatello, ID (United States), 14-16 Feb 1994). Order Number DE94013114. Source: OSTI; NTIS; INIS; GPO Dep.

Inertial Electrostatic Confinement (IEC) is one of the earliest plasma confinement concepts, having first been suggested by P. T. Farnsworth in the 1950s. The concept involves a simple apparatus of concentric spherical electrostatic grids or a combination of grids and magnetic fields. An electrostatic structure is formed from the confluence of electron or ion beams. Gridded IEC systems have demonstrated neutron yields as high as $2*10^{10}$ neutrons/sec. These systems have considerable potential as small, inexpensive, portable neutron sources for assaying applications. Neutron tomography is also a potential application. Atomic physics effects strongly influence the performance of all of these systems. Important atomic effects include elastic scattering, ionization, excitation, and charge exchange. This paper discusses how an IEC system is influenced by these effects and how to design around them. Theoretical modeling and experimental results are presented.

23232 (LA-UR–94-1823) **Startup and shutdown of the PULSAR Tokamak Reactor.** Werley, K.A.; Bathke, C.G. Los Alamos National Lab., NM (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940630–8: 11. topical meeting on the technology of fusion energy, New Orleans, LA (United States), 19-24 Jun 1994). Order Number DE94013128. Source: OSTI; NTIS; INIS; GPO Dep.

Start-up conditions are examined for a pulsed tokamak reactor that uses only inductive plasma current drive for startup, burn and shutdown. A zero-dimensional (profile-averaged) model that describes plasma power and particle balance equations is used to study several aspects of plasma startup and shutdown, including optimization of the startup pathway tradeoff of auxiliary startup heating power versus startup time, volt-second consumtion, thermal stability and partial-power operations.

23233 (LA-UR–94-1868) **Tritium handling and processing experience at TSTA.** Anderson, J.L. (Los Alamos National Lab., NM (United States)); Okuno, K. Los Alamos National Lab., NM (United States). [1994]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940664–7: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94013141. Source: OSTI; NTIS; INIS; GPO Dep.

In 1987, the Japan Atomic Energy Research Institute (JAERI) and the US Department of Energy (DOE) signed a collaborative agreement (Annex IV) for the joint funding and operation of the Tritium Systems Test Assembly (TSTA) at the Los Alamos National Laboratory (LANL) for a five year period ending June, 1992. After this initial five year collaboration, the Annex IV agreement was extended for another two year period ending June, 1994. During the first five years, a number of the integrated process loop tests of TSTA were conducted, as well as off-line testing of TSTA subsystems. During integrated loop testing the vacuum system, fuel cleanup systems, isotope separation system, transfer pumping system and gas analysis system, are interconnected and tested using 100 g-inventories of tritium to demonstrate steady-state operation of a tritium fuel processing cycle for a fusion reactor. These tests have resulted in a number of significant accomplishments and an experience data base on research, development and operation of

the fuel processing system. One of the most significant accomplishments during the initial five year period was the continuous operation of the fuel processing loop for 25 days. During this 25-day extended operation, both the JAERI fuel cleanup system (J-FCU) and the original TSTA fuel cleanup system (FCU) were operated under similar conditions of flow, pressure, and impurity content of the DT gas. Both fuel cleanup systems were demonstrated to provide adequate impurity removal for plasma exhaust gas processing. The isotope separation system was operated continuously, producing pure tritium while rejecting protium as an impurity.

23234 (NIFS–250) **Innovative energy production in fusion reactors.** Iiyoshi, A.; Momota, H.; Motojima, O.; Okamoto, M.; Sudo, S.; Tomita, Y.; Yamaguchi, S.; Ohnishi, M.; Onozuka, M.; Uenosono, C. National Inst. for Fusion Science, Nagoya (Japan). Oct 1993. 22p. Order Number DE94770769. Source: OSTI; NTIS; INIS.

Concepts of innovative energy production in neutron-lean fusion reactors without having the conventional turbine-type generator are proposed for improving the plant efficiency. These concepts are (a) traveling wave direct energy conversion of 14.7 MeV protons, (b) cusp type direct energy conversion of charged particles, (c) efficient use of radiation with semiconductor and supplying clean fuel in a form of hydrogen gas, and (d) direct energy conversion from deposited heat to electric power with semiconductor utilizing Nernst effect. The candidates of reactors such as a toroidal system and an open system are also studied for application of the new concepts. The study shows the above concepts for a commercial reactor are promising. (author).

23235 (NIFS–251) **Characteristics of D-^{3}He fueled frc reactor: ARTEMIS-L.** Momota, H.; Motojima, O.; Okamoto, M.; Sudo, S.; Tomita, Y.; Yamaguchi, S.; Iiyoshi, A.; Onozuka, M.; Ohnishi, M.; Uenosono, C. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 17p. Order Number DE94770774. Source: OSTI; NTIS; INIS.

The paper introduces briefly the scenario and discuss the attractive characteristics of D-3He fueled commercial fusion reactor ARTEMIS-L. By using favorable characteristics of a field-reversed configuration, the fusion plasma of ARTEMIS-L is compact and its beta-value is extremely high. One find consequently a possibility of constructing an economical fusion power power plant on this prospect. The life of the structural materials is sound during the full reactor life (30 years) and the safety of the reactor is intrinsic to D-3He fuels. The amount of disposed materials is rather small and the level of these intruder dose is so low that the plant appears to be acceptable in view of the environment. (author).

23236 (NIFS–252) **Direct energy conversion system for D-^{3}He fusion.** Tomita, Y.; Shu, L.Y.; Momota, H. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 14p. Order Number DE94770773. Source: OSTI; NTIS; INIS.

A novel and highly efficient direct energy conversion system is proposed for utilizing D-^{3}He fueled fusion. In order to convert kinetic energy of ions, we applied a pair of direct energy conversion systems each of which has a cusp-type DEC and a traveling wave DEC (TWDEC). In a cusp-type DEC, electrons are separated from the escaping ions at the first line-cusp and the energy of thermal ion components is converted at the second cusp DEC. The fusion protons go through the cusp-type DEC and arrive at the TWDEC, which principle is similar to 'LINAC.' The energy of fusion protons is recovered to electricity with an efficiency of more than 70%. These DECs bring about the high efficient fusion plant. (author).

23237 (NIFS–253) **Hydrogen production in fusion reactors.** Sudo, S.; Tomita, Y.; Yamaguchi, S.; Iiyoshi, A.; Momota, H.; Motojima, O.; Okamoto, M.; Ohnishi, M.; Onozuka, M.; Uenosono, C. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 18p. Order Number DE94770772. Source: OSTI; NTIS; INIS.

As one of methods of innovative energy production in fusion reactors without having a conventional turbine-type generator, an efficient use of radiation produced in a fusion reactor with utilizing semiconductor and supplying clean fuel in a form of hydrogen gas are studied. Taking the candidates of reactors such as a toroidal system and an open system for application of the new concepts, the expected efficiency and a concept of plant system are investigated. (author).

23238 (NIFS–254) **Direct energy conversion of radiation energy in fusion reactor.** Yamaguchi, S.; Iiyoshi, A.; Motojima, O.; Okamoto, M.; Sudo, S.; Ohnishi, M.; Onozuka, M.; Uenosono, C. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 17p. Order Number DE94770766. Source: OSTI; NTIS; INIS.

Direct energy conversion from plasma heat flux has been studied. Since major parts of fusion energy in the advanced fusion reactor are radiation and charged particle energies, the flexible design of the blanket is possible. We discuss the potentiality of the thermoelectric element that generates electricity by temperature gradient in conductors. A strong magnetic field is used to confine the fusion plasma, therefore, it is appropriate to consider the effect of the magnetic field. We propose a new element which is called Nernst element. The new element needs the magnetic field and the temperature gradient. We compare the efficiency of these two elements in a semiconductor model. Finally, a direct energy conversion are mentioned. (author).

23239 (NIFS–255) **Proposed high speed pellet injection system 'HIPEL' for Large Helical Device.** Sudo, S.; Kanno, M.; Kaneko, H.; Saka, S.; Shirai, T.; Baba, T. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 18p. Order Number DE94770768. Source: OSTI; NTIS; INIS.

From the results of the simulation study including pellet ablation and 1-D transport code, it is found that a high speed pellet injector with pellet velocity of more than 3 km/s is necessary for the penetration of the pellet with diameter of 3 mm into the core region under the expected plasma condition of Large Helical Device (LHD) of heliotron/stellarator type with superconducting coils at NIFS in Japan. Therefore, a two stage pellet injector was constructed and tested successfully in order to obtain the pellet velocity range of 3 km/s. Based upon the above results, a high speed flexible multiple-pellet injection system 'HIPEL' for LHD is proposed. HIPEL consists of independent (1) 10 two-stage gun barrels and (2) 10 single-stage gun barrels. It has multi purposes such as refueling and flexible density profile control, diagnostics and the other functions. (author).

23240 (NIFS–256) **Improvement of a high current DC power supply system for testing the large scaled superconducting cables and magnets.** Yamada, Shuichi (and others); Chikaraishi, Hirotaka; Tanahashi, Shugo. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 23p. Order Number DE94770767. Source: OSTI; NTIS; INIS.

A dc 75 kA power supply system was constructed to test the superconducting (SC) R and D cables and magnets for the Large Helical Device. It consists of three 25 kA unit banks. A unit bank has two double-star-rectifier connections with the inter-phase reactors. A digital feedback control method is applied to the automatic current regulation (ACR) in each unit bank. For shortening the dead time of the feedback process, a new algorithm of a digital phase controller for the ACR is investigated. A Bode diagram of the feedback process is directly measured. It is confirmed that the dead time of the feedback process is reduced to one sixth, and that the feedback gain of PID compensation is improved by a factor of two from the original method. (author).

23241 (NIFS–258) **Design of central control system for large helical device (LHD).** Yamazaki, K.; Kaneko, H.; Yamaguchi, S.; Watanabe, K.Y.; Taniguchi, Y.; Motojima, O. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 17p. Order Number DE94770610. Source: OSTI; NTIS; INIS.

The world largest superconducting fusion machine LHD (Large Helical Device) is under construction in Japan, aiming at steady state operations. Its basic control system consists of UNIX computers, FDDI/Ethernet LANs, VME multiprocessors and VxWorks real-time OS. For flexible and reliable operations of the LHD machine a cooperative distributed system with more than 30 experimental equipments is controlled by the central computer and the main timing system, and is supervised by the main protective interlock system. Intelligent control systems, such as applications of fuzzy logic and neural networks, are planed to be adopted for flexible feedback controls of plasma configurations besides the

classical PID control scheme. Design studies of its control system and related R and D programs with coil-plasma simulation systems are now being performed. The construction of the LHD Control Building in a new site will begin in 1995 after finishing the construction of the LHD Experimental Building, and the hardware construction of the LHD central control equipments will be started in 1996. A first plasma production by means of this control system is expected in 1997. (author).

23242 (NIFS–259) **Reduction of hydrocarbon impurities in 200 L/H helium liquefier-refrigerator system.** Yamada, Shuichi (and others); Mito, Toshiyuki; Nishimura, Arata. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 23p. Order Number DE94770596. Source: OSTI; NTIS; INIS.

A cryogenic system with the capacity of 200 1/h or 500 W at 4.4 K has been operated to develop the superconducting conductors and coils for the LHD. The system has contributed in various superconducting technologies along with the dc 75kA power supply and 10 MN mechanical testing machine, and completed the basic R and D works of the LHD. On the way of operating the cryogenic system, impurity densities of hydrocarbon gases in circulating helium gas became much larger than the expected values for this cryogenic system, so that the densities of some impurity gases were carefully monitored in reference to the operational conditions of circulating compressor by using a gas chromatography. Impurity gas densities of oxygen, nitrogen and ethane increased obviously, when the output capacity of the compressor was reduced. In a two-stage oil injected compression system with a variable stroke mechanism for a first stage, a reduction in the capacity of the first stage leads to a larger compression ratio for the second stage, and the temperature of the injected oil becomes higher. The production of the impurities in the helium might be caused by cracking a part of injected oil in the compressor. The compressor, therefore, was reconstructed such that the injection oil is supplied sufficiently and the compression ratio division becomes even for each stage. It was confirmed that the impurities are not produced now after modification. (author).

23243 (NIFS–260) **Pellet ablation in large helical device.** Kuteev, B.V. (Technical Univ., St. Petersburg (Russian Federation)). National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 61p. Order Number DE94770597. Source: OSTI; NTIS; INIS.

In the program of physical studies on the Large Helical Device (LHD) injection of several hydrogen and deuterium pellets is foreseen. Injection of impurity pellets also may be useful for the plasma diagnostics. The pellet penetration into the LHD plasma is analyzed. In part 1, the present status of the ablation theory and experiment is discussed and an ablation model is formulated. It takes into account energy distribution of the particles (both electrons and ions) participating in the ablation process, electrostatic effects of the cloud charging and changes of pellet form during ablation. Plasma shielding effects are not significant in the ablation. The ablation model is compared with the experiments on T-10, JET, TFTR, Heliotron-E and Tore Supra in part 2. Finally, in part 3, several regimes of the pellet injection into the LHD plasma are simulated including multiple-pellet sequence injection. Optimization of the injection regime is discussed. (author).

23244 (NIFS–261) **Proposal of 'modular heliotron': Advanced modular helical system compatible with closed helical divertor.** Yamazaki, Kozo. National Inst. for Fusion Science, Nagoya (Japan). Nov 1993. 31p. Order Number DE94770598. Source: OSTI; NTIS; INIS.

A new modular helical configuration named 'Modular Heliotron' with clean and efficient helical magnetic divertor is proposed as an extension of the present conventional design of the continuous helical coil system. The sectored helical coils on one plane of the torus and the sectored returning vertical field coils on the other plane are combined. This coil system produces magnetic surfaces nearly equivalent to those of the l=2 helical system with one-pair poloidal coils, and overcomes the defects of construction and maintenance difficulties of the continuous coil systems. This concept satisfies the compatibility between the coil modularity and the sufficient divertor-space utilization, different from previous modular coil designs. The allowable length of the gap between each modular coil is clarified to keep good magnetic surfaces. Typical examples of the reactor coil configuration are described as an extension of the LHD (Large Helical Device) configuration. (author).

23245 (ORNL/FTR–4846) **Travel to Italy for meeting on fusion reactor materials: Foreign trip report, September 26–October 2, 1993.** Rowcliffe, A.F.; Bloom, E.E.; Grossbeck, M.L.; Kenik, E.A.; Klueh, R.L.; Mansur, L.K.; Pawel, J.E.; Snead, L.L.; Zinkle, S.J. Oak Ridge National Lab., TN (United States). 16 Dec 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004498. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The International Conference on Fusion Reactor Materials was the sixth meeting in the series. Three-hundred-and-forty papers were presented dealing with structural materials for first wall and blanket, plasma-facing materials, breeding and neutron multiplier materials, hydrogen/tritium effects, corrosion, compatibility, and joining. This report contains highlights from each of these areas. In conjunction with the conference, there were 16 satellite meetings dealing with various US bilateral collaborative programs and programs being pursued under the auspices of the International Energy Agency (IEA). Brief summaries of these meetings are presented. This report also contains reports of team members' visits to Kernforschungszentrum Karlsruhe (KfK), Kernforschungsanlage (KFA) Juelich, IEA Lucerne, and the International Thermonuclear Experimental Reactor (ITER) Garching site.

23246 (ORNL/FTR–4864) **Travel to Germany to participate in design of International Thermonuclear Experimental Reactor: Foreign trip report, October 27–November 24, 1993.** Haines, J.R.; Ryan, P.M.; Lousteau, D.C.; Taylor, D.J. Oak Ridge National Lab., TN (United States). 10 Jan 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94005437. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The United States is participating with the European Community, Japan, and the Russian Federation in the design of the ITER. The ITER design activities are being led by a Joint Central Team located at three work sites–Garching, Germany; Naka, Japan; and San Diego, California, while design support and R&D activities are performed within the home countries of the participants. At a meeting of the, ITER Council in October, it was agreed that the parties would send additional technical experts to the three joint work sites in November and December to assist the permanent staff in performing tasks required to maintain the project schedule. The coauthors traveled from ORNL to Garching as part of this effort. While in Garching, Phil Ryan and Dave Taylor worked on the design of the Ion Cyclotron Heating System, John Haines on Diverter Design, and Dave Lousteau on Design Integration.

23247 (ORNL/FTR–4874) **Travel to France for the Tore Supra Steering Committee Meeting: Foreign trip report, November 13–24, 1993.** Hoffman, D.J.; Milora, S.L. Oak Ridge National Lab., TN (United States). 20 Dec 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004749. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The trip report presents the discussions and results at three sites. Cadarache, the status and future plans of the Department of Energy (DOE)/Commissariat a l'Energie Atomique (CEA) collaboration were reviewed. The focus of this report is on the radio frequency and pellet fueling aspects of the program. (2) At the Max-Planck-Institute, the pellet fueling review paper was finalized. In the rf area, the travelers helped complete the special ITER design on the rf antennas and discussed possible collaborations between Oak Ridge National Laboratory (ORNL) and IPP-Garching, on Axially Symmetric Divertor Experiment Upgrade (ASDEX-U). (3) At ENEA-Frascati, future plans in the joint effort on development of a repeating two-stage light gas gun and the possible incorporation of ENEA rf support for the folded waveguide experiment on Alcator C-Mod were discussed.

23248 (ORNL/FTR–4881) **Travel to Japan for meeting on ICRF heating antennas: Foreign trip report, November 30–December 16, 1993.** Rasmussen, D.A. Oak Ridge National Lab., TN (United States). 13 Jan 1994. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400.

Order Number DE94005438. Source: OSTI; NTIS (US Sales Only); GPO Dep.

An extended visit was made to the NIFS CHS experiment to participate in the initial operation of five new and modified ICRF antennas. One week's worth of experiments were performed with the antennas; one was newly fabricated and four were modified to reduce their interference with the edge plasma. The plasma performance, antenna cleanliness, and transmitter power limits were gradually improved throughout the operating week. Modest success with ICRF heating up to 700 kW was achieved by the end of the week. Initial controlled scans of the magnetic field, plasma density and ICRF/Neutral Beam Injection (NBI) heating sequence allowed favorable operating conditions to be identified. No serious difficulties with the antennas were observed and subsequent operation should result in good plasma coupling of the ICRF with total injected power greater than 1 MW. A presentation was made to the CHS experimental and heating groups for an ORNL collaboration in ICRF involving modification of the existing single strap antenna design to one with two straps. This modification allows for a phased antenna with the capability for fast wave direct electron heating (DEH) or ion minority heating with waves with non-zero $k_{\|}$. This presentation was favorably received and planning of future collaborations was begun.

23249 (PPPL–2993) **First measurements of tritium recycling in TFTR.** Skinner, C.H.; Adler, H.; Budny, R.V.; Kamperschroer, J.; Johnson, L.C.; Ramsey, A.T.; Stotler, D.P. Princeton Univ., NJ (United States). Plasma Physics Lab. Jun 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE94013101. Source: OSTI; NTIS; INIS; GPO Dep.

The first spectroscopic measurements of tritium Balmer-alpha (T_α) emission from a fusion plasma were made on TFTR using a Fabry-Perot interferometer. The T_α emission line is partially blended with the D_α line (deuterium-alpha), commonly used in edge plasma diagnostics, and the contributions of H_α, D_α, and T_α, are separated by spectral analysis. The data are a measure of the fueling of the plasma by tritium accumulated in the TFTR limiter, as well as the amount of neutral tritium generated by charge exchange of plasma ions. The $T\alpha$ line first became detectable in a high power, tritium only, neutral beam injection discharge at the level of $T_\alpha/(H_\alpha+D_\alpha+T_\alpha)$ = 2%. Subsequently this ratio has increased to as high as 7.5%. Data on the time evolution of the T_α emission during a single discharge and over a series of tritium and deuterium discharges are presented.

23250 (SAND–94-0993C) **Lithium ion beam driven hohlraums for PBFA II.** Dukart, R.J. Sandia National Labs., Albuquerque, NM (United States). 6 May 1994. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940552–5: 10. topical conference on high-temperature plasma diagnostics, Rochester, NY (United States), 8-12 May 1994). Order Number DE94011939. Source: OSTI; NTIS; INIS; GPO Dep.

In our light ion inertial confinement fusion (ICF) program, fusion capsules are driven with an intense x-ray radiation field produced when an intense beam of ions penetrates a radiation case and deposits energy in a foam x-ray conversion region. A first step in the program is to generate and measure these intense fields on the Particle Beam Fusion Accelerator II (PBFA II). Our goal is to generate a 100-eV radiation temperature in lithium ion beam driven hohlraums, the radiation environment which will provide the initial drive temperature for ion beam driven implosion systems designed to achieve high gain. In this paper, we describe the design of such hohlraum targets and their predicted performance on PBFA II as we provide increasing ion beam intensities.

23251 (SAND–94-1239C) **PBFA II lithium beam characterization from inner-shell x-ray images.** Moats, A.R.; Derzon, M.S.; Chandler, G.A.; Dukart, R.J.; Haill, T.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940552–6: 10. topical conference on high-temperature plasma diagnostics, Rochester, NY (United States), 8-12 May 1994). Order Number DE94011938. Source: OSTI; NTIS; INIS; GPO Dep.

The Particle Beam Fusion Accelerator (PBFA II) is not driving targets with ICF-relevant lithium ion beams. During the most recent lithium beam target series, time-integrated x-ray pinhole cameras viewed the ion-induced inner-shell x-ray fluorescence from the central gold cone target and a titanium-coated strip. Ion beam profiles at a nominal 10 mm radius and fixed azimuthal direction were obtained from images of the Ti K_α, fluorescence of a Ti-coated Al diagnostic wire. The gold cone gave us beam profiles at a nominal 3 mm radius and at all azimuthal angles from the Au L_α fluorescence. From these profiles, we obtained the ion beam vertical focus position, full-width-at-half-maximum, and the degree of azimuthal uniformity for the lithium target shots. For these initial results, beam steering problems were evident. Azimuthal uniformity was measured from the ion beam footprint on the outer Au case (predominantly Au L_α) of the hohlraum target and were found to be in the same range (up to 30%) as for previous proton beam target series. We then present plans for Li beam diagnostics for an upcoming target experimental series.

23252 (SAND–94-8625C) **Density and composition analysis using focused MeV ion microbeam techniques.** Antolak, A.J. (Sandia National Labs., Livermore, CA (United States)); Pontau, A.E.; Morse, D.H.; Bench, G.S.; Heikkinen, D.W.; Weirup, D.L. Sandia National Labs., Albuquerque, NM (United States); Lawrence Livermore National Lab., CA (United States). [1994]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000 ; W-7405-ENG-48. (CONF-940524–5: 8. symposium on radiation measurements and applications, Ann Arbor, MI (United States), 16-19 May 1994). Order Number DE94012241. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear microscopy uses focused MeV ion microbeams to nondestructively characterize materials and components with micron scale spatial resolution. Although a number of accelerator-based microbeam methods are available for materials analysis, this paper centers on the techniques of Ion Microtomography (IMT) and Particle-Induced X-ray Emission (PIXE). IMT provides quantitative three-dimensional density information with micron-scale spatial resolution and 1% density variation sensitivity. Recently, IMT has become more versatile because greater emphasis has been placed on understanding the effects of reconstruction artifacts, beam spatial broadening, and limited projection data sets. PIXE provides quantitative elemental information with detection sensitivities to 1 μg/g or below in some instances. By scanning the beam, two-dimensional maps of elemental concentration can also be recorded. However, since x-rays are produced along the entire path of the ion beam as it penetrates the sample, these measurements only give depth-averaged information in general. PIXE tomography (PIXET) is the natural extension from conventional PIXE analysis to the full three-dimensional measurement and forms the bridge linking the complementary techniques of PIXE and IMT. This paper presents recent developments and applications of these ion beam techniques in a diverse range of fields including characterizing metal-matrix composites, biological specimens and inertial confinement fusion targets.

23253 (UCRL-JC–115748) **The logic behind thick, liquid-walled, fusion concepts.** Moir, R.W. Lawrence Livermore National Lab., CA (United States). 15 Apr 1994. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940664–2: 3. international symposium on fusion nuclear technology, Los Angeles, CA (United States), 27 Jun - 1 jul 1994). Order Number DE94012678. Source: OSTI; NTIS; INIS; GPO Dep.

It may be possible to surround the region where fusion reactions are taking place with a neutronically thick liquid blanket which has penetrations that allow only a few tenths of a percent of the neutrons to leak out. Even these neutrons can be attenuated by adding an accurately placed liquid or solid near the target to shadow-shield the beam ports from line-of-sight neutrons. The logic of such designs are discussed and their evolution is described with examples applied to both magnetic and inertial fusion (HYLIFE-II). These designs with liquid protection are self healing when exposed to pulsed loading and have a number of advantages-over the usual designs with solid first walls. For example, the liquid-protected solid

components will last the life of the plant, and therefore the capacity factor is estimated to be approximately 10% higher than for the non-liquid-walled blankets, because no blanket replacement shutdowns are required. The component replacement, operations, and maintenance costs might be half the usual value because no blanket change-out costs or accompanying facilities are required. These combined savings might lower the cost of electricity by 20%. Nuclear-grade construction should not be needed, largely because the liquid attenuates neutrons and results in less activation of materials. Upon decommissioning, the reactor materials should qualify for disposal by shallow burial even when constructed of ordinary 304 stainless steel. The need for a high-intensity 14-MeV neutron test facility to develop first-wall materials is avoided or greatly reduced, saving billions of development dollars. Flowing molten Li, the molten salt Flibe (Li_2BeF_4), and molten $Li_{17}Pb_{83}$ have been considered. An advantage of molten salt is that it will not burn and has a low tritium solubility and therefore low tritium inventory.

23254 (UCRL-JC–116818) **Effect of the stimulated Brillouin backscattering on selffocusing threshold.** Rubenchik, A.M. (Lawrence Livermore National Lab., CA (United States)); Shapiro, E.G.; Turitsyn, S.K. Lawrence Livermore National Lab., CA (United States). Mar 1994. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-940871–1: European quantum electronics conference '94, Amsterdam (Netherlands), 28 Aug - 2 sep 1994). Order Number DE94008678. Source: OSTI; NTIS; INIS; GPO Dep.

In many physical problems stimulated Brillouin scattering (SBS) and selffocusing are manifested simultaneously. We consider effect of the stimulated Brillouin backscattering (SBS) on self-focusing of laser radiation in plasmas. It was found that the self-focusing may be supressed substantionally by the SBS effect.

99 GENERAL AND MISCELLANEOUS

23255 (DOE/EIA–0546(92)) **Energy education resources: Kindergarten through 12th grade.** Altman, P. (comp.). National Energy Information Center, Washington, DC (United States). Dec 1992. 31p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008248. Source: OSTI; NTIS; GPO Dep.

This publication is the result of a study undertaken by the National Energy Information Center (NEIC), a service of the Energy Information Administration (EIA), to provide its customers with a list of generally available free or low-cost energy-related education materials for primary and secondary students and educators. The list is updated once a year.

23256 (IKMz–93-1) **Institute of Nuclear Chemistry, Mainz University. Annual report 1992.** Denschlag, H.O. (ed.). Mainz Univ. (Germany). Inst. fuer Kernchemie. Mar 1993. 84p. Order Number DE94774249. Source: OSTI; NTIS (US Sales Only); INIS.

Brief reports summarise the 1992 achievements of the four departments of the Institute relating to the subject areas: Chemistry of most heavy elements, fast separation methods, equipment development, decay properties and structures of nuclei, heavy ion reactions, environmental analytics. The list of publications and lectures of Institute members is given in an annex. (orig.)

23257 (SAND–94-1155C) **Math and science illiteracy: Social and economic impacts.** Williams, J.L. Sandia National Labs., Albuquerque, NM (United States). [1994]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940646–2: Society of Women Engineers national convention and student conference, Pittsburgh, PA (United States), 22-24 Jun 1994). Order Number DE94010801. Source: OSTI; NTIS; GPO Dep.

Today's highly competitive global economy is being driven by increasingly rapid technological development. This paper explores the problems of math and science illiteracy in the United States and the potential impact on our economic survival in this environment during the next century. Established educational methods that reward task performance, emphasize passive lecture, and fail to demonstrate relevance to real life are partly to blame. Social norms, stereotypes, and race and gender bias also have an impact. To address this crisis, we need to question the philosophy of an educational system that values task over concept. Many schools have already initiated programs at all grade levels to make math and science learning more relevant, stimulating, and fun. Teaching methods that integrate math and science learning with teamwork, social context, and other academic subjects promote the development of higher-order thinking skills and help students see math and science as necessary skills.

9901 Management

Refer also to citation(s) 21075, 21087, 21334, 21701, 21716, 21729, 22053, 22054, 22207, 22747, 23333

23258 (DOE/ET–0019) **Used energy-related laboratory equipment grant program for institutions of higher learning: Eligible equipment catalog.** USDOE Office of Energy Research, Washington, DC (United States). Office of University and Science Education Programs. Jul 1994. 664p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94012991. Source: OSTI; NTIS; GPO Dep.

This is a listing of energy related equipment available through the Energy-Related Laboratory Equipment Grant Program which grants used equipment to institutions of higher education for energy-related research. Information included is an overview of the program, how to apply for a grant of equipment, eligibility requirements, types of equipment available, and the costs for the institution.

23259 (DOE/IG–0001/94) **Semiannual report to Congress, October 1, 1993–March 31, 1994.** USDOE Office of Inspector General, Washington, DC (United States). Apr 1994. 74p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Report to The Secretary.

The report summarizes significant audit, inspection and investigative accomplishments for the reporting period. a large portion of which evaluated management controls that the Department of Energy uses to ensure efficient and effective operation of its programs. During this period, the Office of Inspector General (OIG) issued 128 audit and eight inspection reports. OIG also issued 37 investigative referrals to management for corrective action. As a result of audits of contract costs, OIG questioned $665,802 in costs. Management committed to talking corrective actions which OIG estimates will result in a more efficient use of funds totaling $55.9 million. For reports issued during the period, OIG made audit recommendations that when implemented by management, could result in $1.15 billion being put to better use. In addition, the OIG investigations led to 10 criminal convictions and pretrial diversions, as well as criminal and civil prosecutions which resulted in fines and recoveries of $4,052,206.

23260 (DOE/IG–0349) **Audit of the Uranium Solidification Facility at the Savannah River Site.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 25 May 1994. 11p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Report to The Secretary.

In the late 1980s, DOE decided to construct a Uranium Solidification Facility at the Savannah River Site to process liquid uranyl nitrate into powder. Since the need for weapons materials has been reduced, an audit was conducted to assess the need for this facility. The audit disclosed that DOE continued to construct the facility, because DOE's procedures did not ensure that projects of this type were periodically reassessed when significant program changes occurred. The audit identified more economical alternatives for processing existing quantities of liquid uranyl nitrate at the Savannah River Site.

23261 (DOE/S–0109) **Semiannual Report to Congress on Inspector General Audit Reports, October 1, 1993–March 31, 1994.** USDOE, Washington, DC (United States). May 1994. 20p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94013049. Source: OSTI; NTIS; GPO Dep.

During this period the Department took final action on five contract and financial assistance audit reports. At the end of the period

only four reports awaited final action. With regard to operational, financial, and preaward audit, final action was taken on 40 reports, resulting in 84 audit reports needing final action at the end of the period. This report has three sections. The first outlines significant audit accomplishments achieved by the Department during the reporting period. The second section contains the statistical tables that illustrate the status of final action on Inspector General audit reports. The third lists the audit reports that are one year or more past management decision and have not completed final action. This section also provides the status of corrective actions on each of these reports.

23262 (LA-UR-94-1725) **The negotiation and implementation of compliance agreements at DOE facilities: Management issues.** Kunsberg, P.; Morzinski, J.A. Los Alamos National Lab., NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940815-22: International nuclear and hazardous waste management conference, Atlanta, GA (United States), 14-18 Aug 1994). Order Number DE94013117. Source: OSTI; NTIS; GPO Dep.

This study examines the management process associated with the negotiation and implementation of environmental compliance agreements at DOE facilities.

23263 (PNL-SA-23737) **Using Open Plan with Integrated Xbase applications for effective project management solutions.** Freier, K.D.; Hirschi, E.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1994. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9404168-1: WST user conference, Houston, TX (United States), 20-22 Apr 1994). Order Number DE94013327. Source: OSTI; NTIS; GPO Dep.

Open Plan's open architecture allows the user many advantages that are not available from other project management software. One of these advantages is its ability to interface with various database management systems, thereby allowing the user to develop a project management system tailored to their specific needs. This open architecture offers maximum flexability to the user to personalize reports, screens, data structures, and develop customized management systems. Using Xbase, applications can be developed for every facet of a complete project management system including baseline development, performance measurement, reporting, and analysis. These applications can range from simple routines such as user-defined status worksheets, milestone logs and other reports, to complex cost,and schedule control systems. The combined power of Xbase and Open Plan can be used to produce effective project management solutions. Customized applications are easily obtainable allowing the user to gather information more timely and efficiently, produce customized reports, and analyze project management information more effectively.

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Refer also to citation(s) 20741, 20788, 20836, 20843, 20858, 20866, 20933, 20953, 20960, 20968, 20969, 20970, 20973, 20974, 20975, 20976, 20977, 20978, 20989, 21012, 21025, 21032, 21040, 21044, 21056, 21061, 21062, 21095, 21102, 21207, 21232, 21233, 21234, 21237, 21244, 21261, 21340, 21579, 21609, 21620, 21646, 21649, 21652, 21653, 21714, 21715, 21757, 21830, 21831, 21854, 21937, 21961, 22092, 22145, 22154, 22159, 22166, 22171, 22180, 22181, 22191, 22194, 22196, 22222, 22238, 22283, 22284, 22285, 22312, 22353, 22368, 22402, 22443, 22445, 22449, 22451, 22452, 22454, 22463, 22473, 22477, 22483, 22484, 22524, 22525, 22535, 22542, 22547, 22582, 22634, 22635, 22637, 22717, 22720, 22730, 22738, 22768, 22781, 22783, 22934, 22981, 22983, 22986, 22987, 22990, 23072, 23085, 23171, 23181, 23339

23264 (ANL/DIS/TM-12) **Instructions for the preparation of Resource Allocation Support System (RASS) data forms.** Baldwin, T.E.; Buehring, W.A.; Jusko, M.J.; Keisler, J.M.; Whitfield, R.G.; Wolsko, T.D. Argonne National Lab., IL (United States). Mar 1994. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012134. Source: OSTI; NTIS; GPO Dep.

The Resource Allocation Support System (RASS) is a decision-aiding system being developed to assist the US Department of Energy's Office of Waste Management in program and budget decision making. Information about proposed work, developed by DOE program managers and contractors, comprises what is called the RASS database. A set of data forms and worksheets (paper copies) are provided to record information that will be entered into the RASS database. This report contains instructions for preparing the data forms and worksheets.

23265 (ANL/DIS/TM-13) **A two-level formal specification of a defense communications system.** Chisholm, G.H. (Argonne National Lab., IL (United States). Decision and Information Sciences Div.); Kemmerer, R.A. Argonne National Lab., IL (United States). Decision and Information Sciences Div. Apr 1994. 30p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012117. Source: OSTI; NTIS; GPO Dep.

Computer systems are being used in critical situations with sensitive data, which makes it very important to ensure that these systems perform as desired. The defense communications system contains particularly sensitive data. A two-level ASLAN formal specification of a defense communications system is presented. The ASLAN model is designed to enhance the understanding of critical requirements and demands of the defense communications system. For the top-level (high-level) specifications, the structural details of the actual network are actual network are abstracted to allow more time for examining the interactions between the sites and the network. At this level, DataGrams move through the network, although the actual routing decisions are not specified. More details are added in the second-level specification. At this level, structure is added to the network.

23266 (ANL/MCS/CP-81825) **OTTER 3.0.** McCune, W. Argonne National Lab., IL (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9406172-1: 12. Conference on automated deduction (CADE), Nancy (France), 28 Jun - 1 jul 1994). Order Number DE94012451. Source: OSTI; NTIS; GPO Dep.

Short communication. MATHEMATICAL LOGIC/o codes; ALGORITHMS

23267 (ANL/MCS/CP-82092) **Automatic, self-adaptive control of unfold transformations.** Boyle, J.M. Argonne National Lab., IL (United States). [1994]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9406170-1: International Federation for Information Processing (IFIP) conference on programming concepts, methods and calculi, San Miniato (Italy), 6-10 Jun 1994). Order Number DE94012455. Source: OSTI; NTIS; GPO Dep.

I describe an automated approach to partial evaluation based on elementary simplifications and implemented by program transformations. The approach emphasizes program algebra and relies on canonical forms and distributive laws to expose instances to which the elementary simplifications apply. I discuss some of the considerations that led to the design of this approach. This design discussion should be useful both in understanding the structure of the partial evaluation transformations themselves, and as an example of how to approach the design of automated program transformations in general.This approach to partial evaluation has been applied to a number of practical examples of moderate complexity, including eliminating a data structure from a specification of practical interest, a partial-differential-equation solver. This approach has the virtues of being implemented, automated, and able to partially evaluate specifications of practical interest.

23268 (ANL/MCS/CP-82927) **Unstable solitary-wave solutions of the generalized Benjamin-Bona-Mahony equation.** McKinney, W.R. (North Carolina State Univ., Raleigh, NC (United States). Dept. of Mathematics); Restrepo, J.M.; Bona, J.L. Argonne National Lab., IL (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-940719-4: World congress on computational and applied mathematics, Atlanta, GA (United States), 11-15 Jul 1994). Order Number DE94013302. Source: OSTI; NTIS; GPO Dep.

The evolution of solitary waves of the gBBM equation is investigated computationally. The experiments confirm previously derived theoretical stability estimates and, more importantly, yield insights into their behavior. For example, highly energetic unstable solitary waves when perturbed are shown to evolve into several stable solitary waves.

23269 (ANL/MCS/CP–82973) **A compilation system that integrates high performance Fortran and Fortran M.** Foster, I. (Argonne National Lab., IL (United States)); Xu, Ming; Avalani, B.; Choudhary, A. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. CCR-8809615; DABT63-91-C-0028. (CONF-9405100–5: Scalable high performance computing conference, Knoxville, TN (United States), 23 May 1994). Order Number DE94013308. Source: OSTI; NTIS; GPO Dep.

Task parallelism and data parallelism are often seen as mutually exclusive approaches to parallel programming. Yet there are important classes of application, for example in multidisciplinary simulation and command and control, that would benefit from an integration of the two approaches. In this paper, we describe a programming system that we are developing to explore this sort of integration. This system builds on previous work on task-parallel and data-parallel Fortran compilers to provide an environment in which the task-parallel language Fortran M can be used to coordinate data-parallel High Performance Fortran tasks. We use an image-processing problem to illustrate the issues that arise when building an integrated compilation system of this sort.

23270 (ANL/MCS-TM–184) **The impact of HPF data layout on the design of efficient and maintainable parallel linear algebra libraries.** Bischof, C.H. (Supercomputing Research Center, Bowie, MD (United States)); Huss-Lederman, S.; Jacobson, E.M.; Sun, Xiaobai; Tsao, A. Argonne National Lab., IL (United States). Mar 1994. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94012382. Source: OSTI; NTIS; GPO Dep.

In this document, the authors are concerned with the effects of data layouts for nonsquare processor meshes on the implementation of common dense linear algebra kernels such as matrix-matrix multiplication, LU factorizations, or eigenvalue solvers. In particular, they address ease of programming and tunability of the resulting software. They introduce a generalization of the torus wrap data layout that results in a decoupling of "local" and "global" data layout view. As a result, it allows for intuitive programming of linear algebra algorithms and for tuning of the algorithm for a particular mesh aspect ratio or machine characteristics. This layout is as simple as the proposed HPF layout but, in the authors opinion, enhances ease of programming as well as case of performance tuning. They emphasize that they do not advocate that all users need be concerned with these issues. They do, however, believe, that for the foreseeable future "assembler coding" (as message-passing code is likely to be viewed from a HPF programmers' perspective) will be needed to deliver high performance for computationally intensive kernels. As a result, they believe that the adoption of this approach not only would accelerate the generation of efficient linear algebra software libraries but also would accelerate the adoption of HPF as a result. They point out, however, that the adoption of this new layout would necessitate that an HPF compiler ensure that data objects are operated on in a consistent fashion across subroutine and function calls.

23271 (ANL/MSD/CP–83076) **Spontaneous spin polarization of electrons in two-dimensional arrays of quantum dots: Possibilities for a novel quantum coupled computer architecture.** Bandyopadhyay, S. (Univ. of Notre Dame, IN (United States). Dept. of Electrical Engineering); Das, B.; Miller, A.E.; Eastman, J.A. Argonne National Lab., IL (United States). Materials Science Div. May 1994. 12p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Grant AFOSR-91-0211. (CONF-940529–12: 185. Electrochemical Society meeting, San Francisco, CA (United States), 22-27 May 1994). Order Number DE94013425. Source: OSTI; NTIS; GPO Dep.

The idea of using the spin of an electron to encode binary bit information was proposed by Feynman in the 1960s. In this paper the authors show that an array of quantum dots, each containing a single electron, can realize a quantum coupled computer architecture where each electron acts as a bistable logic device and its spin encodes its logic state. Such an architecture has many advantages such as (1) the absence of physical interconnects between devices, (b) ultrafast switching times (spin flip times) of ~1 picosecond for individual devices, (c) extremely high bit density approaching 10 Terabits/cm^2, (4) non-volatile memory, (5) robustness and possible room temperature operation with very high noise margin and reliability, (6) a very low power delay product for switching between logic levels, and (7) a very small power dissipation of a few tens of nanowatts per switching event. In spite of the above advantages, the technology also has some serious drawbacks in that the fan-out of individual logic devices may be small, wiring crossover is very problematic and the devices themselves have no inherent gain so that isolation between input and output is a problem. The authors discuss these problems, and where possible, offer plausible solutions.

23272 (CERN–93-03) **1992 CERN school of computing: Proceedings.** Verkerk, C. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 6 Jul 1993. 348p. (CONF-9208256–: 15. CERN school of computing, L'Aquila (Italy), 3 Aug - 12 sep 1992). Order Number DE94623840. Source: OSTI; NTIS (US Sales Only); INIS.

These Proceedings contain written accounts of most of the lectures given at the 1992 CERN School of Computing, covering a variety of topics. A number of aspects of parallel and of distributed computing were treated in five lecture series: 'Status of parallel computing', 'An introduction to the APE100 computer', 'Introduction to distributed systems', 'Interprocess communication' and 'SHIFT, heterogeneous workstation services at CERN'. Triggering and data acquisition for future colliders was covered in: 'Neural networks for tripper' and 'Architecture for future data acquisition systems'. Analysis of experiments was treated in two series of lectures; 'Off-line software in HEP: Experience and trends', and 'Is there a future for event display?'. Design techniques were the subject of lectures on: 'Computer-aided design of electronics', CADD, computer-aided detector design' and 'Software design, the methods and the tools'. The other lectures reproduced here treated various fields: 'Second generation expert systems', 'Multidatabase in health care systems', 'Multimedia networks, what is new?' 'Pandora: An experimental distributed multimedia system', 'Benchmarking computers for HEP', 'Experience with some early computers' and 'Turing and ACE; lessons from a 1946 computer design'. (orig.).

23273 (CNIC–00706, pp. 74-79) **Method and code of curve fitting considering the uncertainties associated with independent variables.** Zhao Zhixiang (Chinese Nuclear Data Center, IAE (China)). Chinese Nuclear Data Center, Beijing, BJ (China); China Nuclear Information Centre, Beijing, BJ (China). Dec 1992. (CNDC–0011; INDC(CPR)–029/L.). In *Communication of nuclear data progress: No.8 (1992).* 79p. Order Number DE94626623. Source: OSTI; NTIS (US Sales Only); INIS.

The independent variables are also measured data, their uncertainties would affect the results of least square fitting and should be considered. The formalism of least square fitting taking uncertainties associated with independent variables into account are derived and the related code was developed.

23274 (CONF-940719–2) **Nonlinear partial differential equations invariant to a one-parameter family of stretching groups.** Dresner, L. Oak Ridge National Lab., TN (United States). [1994]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From World congress on computational and applied mathematics; Atlanta, GA (United States); 11-15 Jul 1994. Order Number DE94012753. Source: OSTI; NTIS; INIS; GPO Dep.

Nonlinear partial differential equations (PDEs) in one dependent and two independent variables (call them c, z, and t) occur in many technological applications. Typical PDEs and the contexts in which they arise are the following: $c_t = (c^n)_{zz}$, which occurs in plasma physics, hydrology, gas flow in porous media, and applied superconductivity; $cc_t = c_{zz}$, which describes the expulsion of fluid

from a long, slender, heated pipe; $c_t = (c_z{}^{13})_z$, which describes heat transport in turbulent superfluid He-II; and $c_{tt} = (c_{zz/2}) \int_0{}^1 c_z{}^2\, dz$, which describes the motion of a shock-loaded elastic membrane. All of these equations are invariant to a one-parameter family of one-parameter stretching groups of the form $c' = \lambda^\alpha c$, $t' = \lambda^\beta t$, $z' = \lambda z$, $0 < \lambda < \infty$ where λ is the group parameter that labels the individual transformations of a group and α and β are the parameters that label groups of the family. The parameters α and β are connected by a linear relation $M\alpha + N\beta = L$ where M, N, and L are numbers determined by the structure of the PDE. Similarity solutions are of the PDE that are invariant to one group of the family, say, that for which $\alpha = \alpha^*$ and $\beta = \beta^*$. Such solutions have the form $c = t^{\alpha^*/\beta^*}\, y(z/t^{1/\beta^*})$ where y is a function of the single variable $x = z/t^{1/\beta^*}$. When substituted into the PDE yields an ordinary differential equation for the function y(x).

23275 (CONF-940859–21) **Adaptive learning of Multi-Sensor integration techniques with genetic algorithms.** Baker, J.E. Oak Ridge National Lab., TN (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. international symposium on robotics and manufacturing; Maui, HI (United States); 14-18 Aug 1994. Order Number DE94012744. Source: OSTI; NTIS; GPO Dep.

This research focuses on automating the time-consuming process of developing and optimizing multi-sensor integration techniques. Our approach is currently based on adaptively learning how to exploit low-level image detail. Although this system is specifically designed to be both sensor and application domain independent, an empirical validation with actual multi-modal sensor data is presented.

23276 (DOE/ER/25126–1) **Algorithms for mathematical programming: Annual technical progress report, June 15, 1993–June 14, 1994.** Goldfarb, D. Columbia Univ., New York, NY (United States). [1994]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER25126. Order Number DE94013544. Source: OSTI; NTIS; GPO Dep.

Objective is development, analysis, and implementation of algorithms for solving mathematical programming problems. Focus is on simplex algorithms, interior point algorithms, and algorithms that combine interior point and multiplier penalty approaches.

23277 (ESTSC–000154FUJ2401) **KIVA3: 2d & 3d Reactive Flows With Fuel Sprays.** Amsden, A.A. (Los Alamos National Lab, NM (United States)); O'Rourke, P.J.; Butler, T.D.; Ported by Thuy, T.L. Fujitsu Systems Business of America, Inc., Santa Clara, CA (United States). 1 Mar 1993. Sponsored by USDOE, Washington, DC (United States). Source: ESTSC.

Description: FUJITSUVP2400; UXP/M; UXP/M FORTRAN (>99%) C (>1%); 1 Data Cartridge. Source routines are ready for compile and link on the VP2000 series by the script files included in the package. The system dependent routines and the mathematical routines are also included in the package. Graphics post-processor requires some primitives as point plotting, vector drawing, character string conversion, etc.

KIVA3 is a computer program for the numerical calculation of transient, two and three-dimensional, chemically reactive flows with sprays. It is an extension of the earlier KIVA2, and uses the same numerical solution procedure and solves the same set of equations. KIVA3 differs in that it uses a block-structured mesh with connectivity defined through indirect addressing. The departure from a single rectangular structure in logical space allows complex geometries to be modeled with significantly greater efficiency because large regions of deactivated cells are no longer necessary. Cell-face boundary conditions permit greater flexibility and simplification in the application of boundary conditions.

23278 (ESTSC–000428CY00002) **POISSONSUPERFISH4.12: POISSON, SUPERFISH, Magnet and RF Cavity Design.** Holsinger, R.F. (Los Alamos National Lab., NM (United States)); Halbach, K. Los Alamos National Lab., NM (United States). 25 Mar 1993. Sponsored by USDOE, Washington, DC (United States). Source: ESTSC.

Description: CRAY; UNIX; FORTRAN 77 (99%) C (1%); 1 QIC Cartridge. Source files end in .f. The PSFPLOT program generates POSTSCRIPT output, or can use GKS or subroutines INITT, CHRSIZ, TERM, NEWPAG, AOUTST, ANMODE, MOVABS, DRWABS, and TINPUT from the proprietary Tektronix PLOT10. These routines are not included.

POISSON,SUPERFISH is a group of codes that solve Poisson's equation and are used to compute field quality for both magnets and fixed electric potentials and RF cavity codes that calculate resonant frequencies and field distributions of the fundamental and higher modes. The group includes: POISSON, PANDIRA, SUPERFISH, AUTOMESH, LATTICE, FORCE, MIRT, PAN-T, TEKPLOT, SF01, and SHY.

23279 (ESTSC–000556SUN0000) **SSCMAG2.6: Design and Optimize Superconducting Accelerator Magnets.** Archer, B. (Superconducting Super Collider Laboratory, Dallas, TX (United States)); Orrell, D.J.; Snitchler, G.L. Superconducting Super Collider Lab., Dallas, TX (United States). 5 Aug 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Source: ESTSC.

Description: SUN; SUN OS4.1.2; FORTRAN 77 (99%), UNIX C-shell (1%); 1 3.5 Diskette. The IMSL mathematics libraries, PE2D, and UNIGRAPHICS are proprietary software packages.

SSCMAG is an integrated design package for designing the two dimensional magnetic cross section of superconducting particle accelerator magnets. SSCMAG consists of three functional sections. One function determines placement of the conductors to provide an optimized 2-D cross section, whereas, the second function examines the effects of non-optimal conductor placement and the effects of persistent currents and AC-losses. The last function integrates the first two functions and provides output suitable for input by other engineering design packages.

23280 (ESTSC–000645SGIIP00) **RADIANCE2.3: Geometric Modeling, Radiation Simulation, Rendering, Analysis Package.** Ward, G. (Lawrence Berkeley National Lab., CA (United States)). Lawrence Berkeley Lab., CA (United States). 15 Nov 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Source: ESTSC.

Description: SILICON GRAPHIC; UNIX; C; 1 QIC Cartridge.

RADIANCE is intended to aid lighting designers and architects by predicting the light levels and appearance of a space prior to construction. The package includes programs for modeling and translating scene geometry, luminaire data and material properties, all of which are needed as input to the simulation. The lighting simulation itself uses ray tracing techniques to compute radiance values (ie. the quantity of light passing through a specific point in a specific direction), which are typically arranged to form a photographic quality image. The resulting image may be analyzed, displayed and manipulated within the package, and converted to other popular image file formats for export to other packages, facilitating the production of hard copy output.

23281 (ESTSC–000645SPARC00) **RADIANCE2.3: Geometric Modeling, Radiation Simulation, Rendering, Analysis Package.** Ward, G. (Lawrence Berkeley National Lab., CA (United States)). Lawrence Berkeley Lab., CA (United States). 15 Nov 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Source: ESTSC.

Description: SUN SPARC; UNIX; C; 1 QIC Cartridge.

RADIANCE is intended to aid lighting designers and architects by predicting the light levels and appearance of a space prior to construction. The package includes programs for modeling and translating scene geometry, luminaire data and material properties, all of which are needed as input to the simulation. The lighting simulation itself uses ray tracing techniques to compute radiance values (ie. the quantity of light passing through a specific point in a specific direction), which are typically arranged to form a photographic quality image. The resulting image may be analyzed, displayed and manipulated within the package, and converted to other popular image file formats for export to other packages, facilitating the production of hard copy output.

23282 (ESTSC–000660CY00000) **BASIS9.4: The Basis Code Development System.** Allsman, R. (Lawrence Livermore

National Lab., CA (United States)); Barrett, K.; Busby, L.; Chiu, Y.; Crotinger, J.; Dubois, B.; Dubois, P.F.; Langdon, B.; Motteler, Z.C.; Takemoto, J.; Taylor, S.; Willmann, P.; Wilson, S. Lawrence Livermore National Lab., CA (United States). 1 Aug 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Source: ESTSC.

Description: CRAY; Unicos; FORTRAN (with CRAY pointers 75%), C (25%); 1 QIC 150 Cartridge. MPPL language input files normally use an extension of '.M'. CGM (Computer Graphics Metafiles) are usually named with the extension '.cgm'. BASIS9.4 'variable descriptor files' use a '.v' extension. A developer's license for the ATC GKS Graphics Library is recommended. The NCAR (National Center for Atmospheric Research) graphics system is required. The MIT X11 Windowing System (R4 or higher) is required. The Perl programming language, version 4.0 or higher, is required.

BASIS9.4 is a system for developing interactive computer programs in Fortran, with some support for C and C++ as well. Using BASIS9.4 you can create a program that has a sophisticated programming language as its user interface so that the user can set, calculate with, and plot, all the major variables in the program. The program author writes only the scientific part of the program; BASIS9.4 supplies an environment in which to exercise that scientific programming which includes an interactive language, an interpreter, graphics, terminal logs, error recovery, macros, saving and retrieving variables, formatted I/O, and online documentation.

23283 (ESTSC–000660SUN0000) **BASIS9.4: The Basis Code Development System.** Allsman, R. (Lawrence Livermore National Lab., CA (United States)); Barrett, K.; Busby, L.; Chiu, Y.; Crotinger, J.; Dubois, B.; Dubois, P.F.; Langdon, B.; Motteler, Z.C.; Takemote, J.; Taylor, S.; Willman, P.; Wilson, S. Lawrence Livermore National Lab., CA (United States). 1 Aug 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Source: ESTSC.

Description: SUN; Unix; FORTRAN (with CRAY pointers 75%), C (25%); 1 QIC 150 Cartridge. MPPL language input files normally use an extension of '.M'. CGM (Computer Graphics Metafiles) are usually named with the extension '.cgm'. BASIS9.4 'variable descriptor files' use a '.v' extension. A developer's license for the ATC GKS Graphics Library is recommended. The NCAR (National Center for Atmospheric Research) graphics system is required. The MIT X11 Windowing System (R4 or higher) is required. The Perl programming language, version 4.0 or higher, is required.

BASIS9.4 is a system for developing interactive computer programs in Fortran, with some support for C and C++ as well. Using BASIS9.4 you can create a program that has a sophisticated programming language as its user interface so that the user can set, calculate with, and plot, all the major variables in the program. The program author writes only the scientific part of the program; BASIS9.4 supplies an environment in which to exercise that scientific programming which includes an interactive language, an interpreter, graphics, terminal logs, error recovery, macros, saving and retrieving variables, formatted I/O, and online documentation.

23284 (ESTSC–000663SUN0000) **CFDLIB: Computational Fluid Dynamics Library.** Kashiwa, B. (Los Alamos National Lab., NM (United States)); Baumgardner, J.R.; Padial, N. Los Alamos National Lab., NM (United States). 1 Nov 1990. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Source: ESTSC.

Description: SUN; UNIX; FORTRAN 77; 1 3.5 Diskette.

CFDLIB solves the equations for interpentrating continuua. The present version handles NSPC species, organized in up to four fluid classes. Each class has the same average velocity and temperature. That is for example, species one, two, and three, belong to velocity-temperature class one. Species four and five make up class two, and so on. Hence, the species order is important here.

23285 (ESTSC–000688D0VAX00) **REVERB: Acoustical Analysis of a System of Volumes Based on Room Acoustics Theory.** Carosella, D. (CEGA Corporation, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Oct 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape. Compiled without error. Link failed required imsl library not present.

REVERB performs acoustical analysis of an HTGR primary circuit represented as a system of volumes connected at windows. The codes is based on room acoustics theory and it is applicable only to frequencies where the wavelength of the sound wave is much shorter than a typical dimesion of a volume.

23286 (ESTSC–000689D500000) **TWOD: Two-Dimensional Finite Element Stress Analysis Code.** Pelessone, D. (General Atomics, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Oct 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; UNIX; ASCII FORTRAN; 1 Mag Tape.

TWOD is a finite element program for the stress analysis of two-dimesional solids based on generalized plain strain theory. The code contains a library with a large selection of material properties ranging from hyperelastic to plastic-viscous elastic.

23287 (ESTSC–000691D500000) **CONTOUR: Stress Time History Postprocessor Plotting Program.** Pelessone, D. (CEGA Corporation, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Nov 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; Open System Foundation OSF/1; FORTRAN; 1 Mag Tape. Error detected in compiling:MODULE DIGDRV - NO PATH TO SMT LINE 178[WARNING]. Link failed required library not present.

CONTOUR is an in-house computer program which is used at General Atomics to generate contour plots of analysis results obtained from various finite element codes used in stress and thermal analysis of core fuel blocks. The program provides contour and fringe plots of the results in either black and white or color. The input data for CONTOUR is CONDRUM, a word addressable file generated by codes which contain element stresses and nodal displacements such as TWOD and PRINT2. TWOD is a finite element program for linear and nonlinear stress analysis of two-dimensional and axisymetric solids. PRINT2 is an output processor code for printing data.

23288 (ESTSC–000692D500000) **MESH2A: Two-Dimensional Mesh Generator Code.** Pelessone, D. (CEGA Corporation, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 31 Aug 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; Open System Foundation OSF/1; FORTRAN; 1 Mag Tape. Package compiled without error. Link failed required library not present.

MESH2A is an in-house computer program which has been used at General Atomics to check a finite element mesh and generate an output data file.The input mesh data file can be obtained manually or computer generated from codes like COCO, REFINE, or any other mesh generating codes available to the user. The output file of MESH2A is used as input data to thermal analysis code HEAT2, and to stress analysis code TWOD. HEAT2 and TWOD have primarily been used for the thermal and stress analysis of irradiated graphite core components for the HTGR and MHTGR reactor designs.

23289 (ESTSC–000694IBMPC00) **PATH: Gamma Dose Calculations and Shielding Analysis.** Su, S.D. (CEGA Corporation, San Diego, CA (United States)); Baylor, K.J.; Engholm, B.A. General Atomics, San Diego, CA (United States). 1 May 1987. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: IBM PC; DOS; FORTRAN; 1 Mag Tape. Package requires 'Math C' compiler.

PATH is a highly flexible shielding code utilizing the common point-kernel integration technique primarily for treating gamma radiation from reactors, radioactive components and from complex

piping systems. Major features of the code include complex geometry capability, various source options, extensive data library, simple but flexible input and well-organized output format.

23290 (ESTSC–000698D0VAX00) **BLOOST8: Combined Reactor Point Kinetics-Heat Transfer Code for Two-Dimensions.** Merrill, M. (General Atomics, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 12 Aug 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN (100%); 1 Mag Tape. Care must be exercised when modeling a rapid scram following a slow ramp in order to prevent instability in the kinetics calculations. Package compiled without error. Link failed undefined symbols ticker warning reference in documentation to an executable, executable was not found.

BLOOST-8 is a combined reactor kinetics and heat transfer code. The kinetics model employs the space-independent form of the reactor kinetics equations with very general forms of reactivity input and feedback. The heat transfer model consists of a general two-dimensional time-dependent heat transfer program that computes the temperature distribution in a single average fuel element.

23291 (ESTSC–000700D0VAX00) **MICROX: Two-Region Flux Spectrum Code for Calculating Broad Group Cross Sections.** Kock, P. (General Atomics, San Diego, CA (United States)); Walti, P. General Atomics, San Diego, CA (United States). 1 Apr 1972. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape. In the fast energy range all mixtures are processed in parallel and data from the fine point resonance file (GAR) is used only for those energies required by certain criteria for all mixtures; the same mixtures run separately might use data from different energy points and hence the results might be somewhat different. Package compiled without error. Linkage failed undefined symbols (BAKSPC, DATGET, DRMRED, DRMWRT, ENFILE, INOUT, ITE, MERR, REWND, SECRED, SECWRT, SKPFLS, TICKER).

MICROX is an integral transport theory flux spectrum code which solves the neutron slowing down and thermalization equations on a detailed energy grid for a two-region lattice cell for many different mixtures in parallel. The fluxes in the two regions (fuel and moderator) are coupled by collision probabilities and the fuel region may have grain structure. MICROX can handle two types of grains in each cell (mixture). Neutron leakage effects are determined from energy-dependent bucklings. MICROX explicitly accounts for overlap and interference between resonance levels and allows for the simultaneous treatment of leakage and resonance self-shielding. Broad group cross sections are prepared for diffusion and transport theory codes by averaging the basic nuclear data over the calculated flux and current spectra.

23292 (ESTSC–000705D0VAX00) **GOP: HTGR Coolant Impurity Mass Balance.** Richards, M. (CEGA Corporation, San Diego, CA (United States)); Gillespie, A. General Atomics, San Diego, CA (United States). 1 Aug 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape.

GOP is used to predict graphite corrosion rates and overall impurity mass balances for High-Temperature Gas-Cooled Reactors. Both thermal and radiolytic reactions involving the coolant gas impurities H2O, CO2, CO, H2, and CH4 are modeled.

23293 (ESTSC–000706D0VAX00) **COPAR-FD: Release of Metallic Fission Products from Coated Nuclear Fuel Particles.** Tzung, F. (CEGA Corporation, San Diego, CA (United States)); Richards, M. General Atomics, San Diego, CA (United States). 1 Sep 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape. Package compiled without error. Link failed undefined symbols (FORID, MERR, QD0, TICKER).

COPAR-FD is used to calculate the release of metallic fission products from coated nuclear fuel particles, using a finite-difference solution of the governing partial differential equation. COPAR-FD interfaces with the TRAMP and TRAFIC codes for calculating transport in and release from graphite fuel blocks.

23294 (ESTSC–000706D500000) **COPAR-FD: Release of Metallic Fission Products from Coated Nuclear Fuel Particles.** Tzung, F. (CEGA Corporation, San Diego, CA (United States)); Richards, M. General Atomics, San Diego, CA (United States). 1 Sep 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; UNIX; FORTRAN; 1 Mag Tape. Package compiles without error. Link failed undefined symbols (FORID, MERR, QD0, TICKER).

COPAR-FD is used to calculate the release of metallic fission products from coated nuclear fuel particles, using a finite-difference solution of the governing partial differential equation. COPAR-FD interfaces with the TRAMP and TRAFIC codes for calculating transport in and release from graphite fuel blocks.

23295 (ESTSC–000707D0VAX00) **TRAFIC: HTGR Full-Core Release and Transport of Metallic Fission Products.** Smith, P.D. (General Atomics Corporation, San Diego, CA (United States)); Tzung, F. General Atomics, San Diego, CA (United States). 1 Feb 1978. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape. Package compiled without error. Linkage failed. Undefined symbols BAKSPC, DRMRED, DRMWRT, ENFILE, EXTIME, FORID, INOUT, ITE, MERR, REWND, SKPFLS, TICKER.

TRAFIC performs calculations of metallic fission product inventory of the fuel as function of time, and release from failed and intact fuel particles, diffusion through the fuel compact matrix and diffusion and sorption in the fuel element graphite and release to the coolant for HTGR cores under normal operating conditions.

23296 (ESTSC–000708D500000) **MCOCO: Multiple Core Column Seismic Analysis Code.** Almajan, I. (CEGA Corporation, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Apr 1978. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; UNIX; FORTRAN; 1 Mag Tape.

MCOCO is an explicit two-dimensional core seismic dynamic analysis program for the analysis of a vertical slice through the reactor core. It calculates impact loads, displacements and velocities of core blocks. It can model from a minimum of one column (with the option of no support and reflector blocks used) to a large group of columns, three each on one support block with a reflector column and side shield on each side.

23297 (ESTSC–000710D0VAX00) **POKE: HTGR Core Thermalhydraulic Analysis Code.** Kapernick, R. (CEGA Corporation, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Nov 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC VAX; VMS; FORTRAN; 1 Mag Tape.

POKE solves for the steady-state coolant flow rate and temperature distributions in an HTGR core. Core regions are represented by an equivalent number of coolant channels and flow is partitioned by balancing pressure drop across these coolant channels. Solid temperatures are then calculated using either equivalent conductances or an analytic solution to the unit cell within a standard HTGR fuel block. Output includes both printed results and temperature plot files.

23298 (ESTSC–000711D500000) **OXIDE4: Graphite-Water Oxidation Reactions in a Modular High Temperature Gas-Cooled Rear.** Peeroomian, M.B. (General Atomics, San Diego, CA (United States)); Barsell, A.W.; Saeger, J.C.; Landoni, J.H.; Tangirala, V. General Atomics, San Diego, CA (United States). 23 Sep 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; ULTRIX; FORTRAN; 1 Mag Tape. Package compiled without error. Linkage failed undefined symbols (MERR, TICKER, WARN).

OXIDE4 is developed for the purpose of analyzing the transient effects of accidental inleakage of steam and/or air to the primary coolant system of MHTGR.

23299 (ESTSC–000712D500000) **WEIBULL: Crack Initiation Probability Code.** Pelessone, D. (General Atomics, San Diego, CA (United States)). General Atomics, San Diego, CA (United States). 1 Nov 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CH10438. Source: ESTSC.

Description: DEC 5000 WS; UNIX; FORTRAN; 1 Mag Tape. To create an executable, the code must be linked with GA smb.library containing special purpose I/O routines. Package compiled without error. Linkage failed undefined symbol (DRMRED). Documentation references make and object file, could not find.

WEIBULL calculates crack initiation probability given a stress distribution history over the volume of a graphite component.

23300 (ESTSC/NRC–000579IBMPC01) **REMIT3.5: Radiation Exposure Monitoring and Information Transmittal System.** Cale, R. (Science Applications International Corporation, Oak Ridge, TN (United States)); Clark, T.; Dixson, P.; Hagemeyer; Hardwick, C.; Pippen, H. Science Applications International Corp., Oak Ridge, TN (United States). 1 Apr 1993. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM PC; MS-DOS 3.31 or higher; Foxpro 2.0; 2 3.5 Diskettes. SOURCE CODE IS NOT INCLUDED WITH PACKAGE. Filename extensions: BAT MS-DOSBatch File, CDX Foxpro compound index, COM MS-DOS executable, DBF Foxpro database file, ESL Foxpro overlay file, ESO Foxpro overlay file, EXE MS-DOS executable, FPT Foxpro memo file, ZIP PKZIP 1.1 compatible compressed file. Installation software: INSTALL.EXE, INSTALL.CFG, COPYFILE.BAT, UNZIP.EXE.

The Radiation Exposure Monitoring and Information Transmittal (REMIT) system is designed to assist U.S. Nuclear Regulatory Commission (NRC) licensees in meeting the reporting requirements of the Revised 10 CFR Part 20 and in agreement with the guidance contained in Regulatory Guide 8.7, Rev.1, Instructions for Recording and Reporting Occupational Exposure Data. REMIT is a personal computer (PC)-based menu driven system that facilitates the manipulation of data base files to record and report radiation exposure information. REMIT is designed to be user-friendly and contains the full text of Regulatory Guide 8.7, Rev.1, on-line as well as context-sensitive help throughout the program. The user can enter data directly from NRC Form 5s or Form 4s. REMIT allows the user to view the individual's exposure in relation to regulatory or administrative limits and will alert the user to exposures in excess of these limits. The system also provides for the calculation and summation of dose from intakes and the determination of the dose to the maximally exposed extremity for the monitoring year. REMIT can produce NRC Form 5s and 4s in paper and electronic format and can import/export data from ASCII and data base files.

23301 (ESTSC/NRC–000646I036000) **SNAKE: A Solid Angle Calculational System.** Thompson, J.K. (Pacific Northwest Lab., Richland, WA (United States)); Lewallen, M.A.; Trapp, J.T. Oak Ridge National Lab., TN (United States). 1 Feb 1978. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM360; IBM 360/370; FORTRAN IV; ASSEMBLER; 1 3.5 Diskette.

SNAKE calculates solid angles subtended by geometric forms composed of spherical, cylindrical, and planar surfaces, either singularly or in specified arrays, from exact analytic integral forms. Thus, it is capable of providing information necessary for the solid angle method for evaluation of neutron interaction in arrays.

23302 (ESTSC/NRC–000674IBMPC00) **TR-EDB: Test Reactor Embrittlement Data Base, Version 1.** Stallman, F.W. (Oak Ridge National Lab, TN (United States)); Wang, J.A.; Kam, F.B.K. Oak Ridge National Lab., TN (United States). 1 Jan 1994. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM PC; DOS; dBASE Format; 1 3.5 Diskette.

TR-EDB is a collection of results from irradiations in materials test reactors. It complements the Power Reactor Embrittlement Data Base (PR-EDB), whose data are restricted to the results from the analysis of surveillance capsules in commercial power reactors. The rationale behind this restriction was the assumption that the results of test reactor experiments may not be applicable to power reactors and could, therefore, be challenged if such data were included.

23303 (ESTSC/NRC–000678IBMPC00) **Q&A: Questions and Answers Based on Revised 10 CFR Part 20.** Borges, T. (Oak Ridge National Lab., TN (United States)); Stafford, B.; Lu, P.Y.; Carter, D. Oak Ridge National Lab., TN (United States). 15 Apr 1994. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Reactor Regulation. Source: ESTSC.

Description: IBM PC; DOS; FoxPro (97%) Clipper; 1 3.5 Diskette. The program can be run from the specified diskette or installed onto a hard drive. QA.EXE runs the program. Installation information and other information is obtained by printing the help file.

The program is identical to NUREG/CR-6204 which is a collection of questions and answers originally issued in seven sets that pertain to revised 10 CFR Part 20. The questions came from outside and within the NRC. The answers were compiled and provided by NRC staff within the offices of Nuclear Reactor Regulation, Nuclear Material Safety and Safeguards, Nuclear Regulatory Research, the Office of State Programs, and the five regional offices. Although all of the questions and answers have been reviewed by attorneys in the NRC Office of the General Counsel, they do not constitute official legal interpretations relevant to revised 10 CFR Part 20. The questions and answers do, however, reflect NRC staff decisions and technical opinions on aspects of the revised 10 CFR Part 20 regulatory requirements.

23304 (ESTSC/NRC/R–000654IBMPC00) **PR-EDB: Power Reactor Embrittlement Data Base, Version 2.** Stallman, F.W. (Oak Ridge National Lab., TN (United States)); Wang, J.A.; Kam, F.B.K.; Taylor, B.J. Oak Ridge National Lab., TN (United States). 1 Jan 1994. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Source: ESTSC.

Description: IBM PC; DOS; dBASE Format; 1 3.5 Diskette. The current version of the PR-EDB lists the test results of 98 heat-affected-zone (HAZ) materials, 105 weld materials, and 136 base materials, including 98 plates, 35 forgings, and 3 correlation monitor materials that were irradiated in 252 capsules from 96 reactors.

Investigation of regulatory issues such as vessel integrity over plant life, vessel failure, and sufficiency of current codes, Standard Review Plans (SRPs), and Guides for license renewal can be greatly expedited by the use of a well-designed computerized data base. Also, such a data base is essential for the validation of embrittlement prediction models by researchers. The Power Reactor Embrittlement Data Base (PR-EDB) is such a comprehensive collection of U.S. designed commercial nuclear reactors.

23305 (FNAL/C–94/111) **Production Farms at Fermilab.** Fischler, M.; Rinaldo, F.; Wolbers, S. Fermi National Accelerator Lab., Batavia, IL (United States). May 1994. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-940492–1: Meeting on computing in high-energy physics, San Francisco, CA (United States), 21-27 Apr 1994). Order Number DE94013148. Source: OSTI; NTIS; INIS; GPO Dep.

UNIX Farms at Fermilab have been used for more than than three years to solve the problem of providing massive amounts of CPU processing power for event reconstruction. System configurations, parallel processing software, administration and allocation issues, production issues and other experiences and plans are discussed.

23306 (INIS-mf–13778, pp. 5-6) **A frequency domain theory for sampled-data control systems: Basic results and the H_∞ problem.** Araki, M. (Kyoto Univ. (Japan)); Itoh, Y.; Hagiwara, T. Ministry of Science and Development, Jerusalem (Israel). Oct 1993. 165p. (CONF-9310325–: International conference on control theory and its applications, Kibbutz Maale HaChamisha (Israel), 18-21 Oct 1993). In *International conference on control theory and its applications: Scientific programme and abstracts.* Order Number DE94626221. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CONTROL THEORY/feedback; FEEDBACK; MATHEMATICS; SAMPLING

23307 (INS-T–520) **The 9-th INS scientific computational programs.** Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1993. 55p. (In Japanese). Order Number DE94770780. Source: OSTI; NTIS; INIS.

Twelve groups were accepted as the 9-th INS Scientific Computational Programs (ISCP). This ISCP can use full resources of the INS central computer without an operational limitation. The 9-th ISCP started at June/1/92 and ended at March/30/93. Some results were already published in journals or appeared in physical meetings. This is a sum of the used statistics of the 9-th ISCP and reports presented by groups performed the 9-th ISCP. (author).

23308 (JAERI-M–93-230) **Parallelization of MCNP4 code by using simple FORTRAN algorithms.** Yazid, P.I. (National Atomic Energy Agency, Jakarta (Indonesia). Research Centre for Nuclear Techniques); Takano, Makoto; Masukawa, Fumihiro; Naito, Yoshitaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1993. 86p. Order Number DE94770763. Source: OSTI; NTIS; INIS.

Simple FORTRAN algorithms, that rely only on open, close, read and write statements, together with disk files and some UNIX commands have been applied to parallelization of MCNP4. The code, named MCNPNFS, maintains almost all capabilities of MCNP4 in solving shielding problems. It is able to perform parallel computing on a set of any UNIX workstations connected by a network, regardless of the heterogeneity in hardware system, provided that all processors produce a binary file in the same format. Further, it is confirmed that MCNPNFS can be executed also on Monte-4 vector-parallel computer. MCNPNFS has been tested intensively by executing 5 photon-neutron benchmark problems, a spent fuel cask problem and 17 sample problems included in the original code package of MCNP4. Three different workstations, connected by a network, have been used to execute MCNPNFS in parallel. By measuring CPU time, the parallel efficiency is determined to be 58% to 99% and 86% in average. On Monte-4, MCNPNFS has been executed using 4 processors concurrently and has achieved the parallel efficiency of 79% in average. (author).

23309 (JAERI-M–94-026) **Development of REFLA/TRAC code for engineering work station.** Ohnuki, Akira (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Akimoto, Hajime; Murao, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1994. 68p. (In Japanese). Order Number DE94770640. Source: OSTI; NTIS; INIS.

The REFLA/TRAC code is a best-estimate code which is expected to check reactor safety analysis codes for light water reactors (LWRs) and to perform accident analyses for LWRs and also for an advanced LWR. Therefore, a high predictive capability is required and the assessment of each physical model becomes important because the models govern the predictive capability. In the case of the assessment of three-dimensional models in REFLA/TRAC code, a conventional large computer is being used and it is difficult to perform the assessment efficiently because the turnaround time for the calculation and the analysis is long. Then, a REFLA/TRAC code which can run on an engineering work station (EWS) was developed. Calculational speed of the current EWS is the same order as that of large computers and the EWS has an excellent function for multidimensional graphical drawings. Besides, the plotting processors for X-Y drawing and for two-dimensional graphical drawing were developed in order to perform efficient analyses for three-dimensional calculations. In future, we can expect that the assessment of three-dimensional models becomes more efficient by introducing an EWS with higher calculational speed and with improved graphical drawings. In this report, each outline for the following three programs is described: (1) EWS version of REFLA/TRAC code, (2) Plot processor for X-Y drawing and (3) Plot processor for two-dimensional graphical drawing. (author).

23310 (LA–12746-M) **Interchangeable spline reference guide.** Dolin, R.M. Los Alamos National Lab., NM (United States). May 1994. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE94012368. Source: OSTI; NTIS; GPO Dep.

The WX-Division Integrated Software Tools (WIST) Team evolved from two previous committees, First was the W78 Solid Modeling Pilot Project's Spline Subcommittee, which later evolved into the Vv'X-Division Spline Committee. The mission of the WIST team is to investigate current CAE engineering processes relating to complex geometry and to develop methods for improving those processes. Specifically, the WIST team is developing technology that allows the Division to use multiple spline representations. We are also updating the contour system (CONSYS) data base to take full advantage of the Division's expanding electronic engineering process. Both of these efforts involve developing interfaces to commercial CAE systems and writing new software. The WIST team is comprised of members from V;X-11, -12 and 13. This "cross-functional" approach to software development is somewhat new in the Division so an effort is being made to formalize our processes and assure quality at each phase of development. Chapter one represents a theory manual and is one phase of the formal process. The theory manual is followed by a software requirements document, specification document, software verification and validation documents. The purpose of this guide is to present the theory underlying the interchangeable spline technology and application. Verification and validation test results are also presented for proof of principal.

23311 (LA-UR–93-3104) **Simple Interim Directory (SID).** Hoebelheinrich, R.L. Los Alamos National Lab., NM (United States). 1 Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940826–1: International Foundation of Information Processing (IFIP) conference on information technology and new emergent forms of organization, Ann Arbor, MI (United States), 13-15 Aug 1994). Order Number DE93040143. Source: OSTI; NTIS; GPO Dep.

The Simple Interim Directory (SID) is a set of ndbm utilities and files that provide electronic mail address information for an institution wide electronic mail system. The purpose of SID is to maintain these Email addresses for review, distribution and dynamic message routing. Email addresses are included for individuals, mail lists and services. The Email addresses and personal information are contained in a data base known as the Email Address Directory (EMAD) and maintained with a registration interface known as the Email Registration (EMR). This database is distributed and maintained by the Email Name Registration (ENR).

23312 (LA-UR–94-1290) **Gas film lubrication equations for very small clearances.** Sobehart, J.R. (Los Alamos National Lab., NM (United States)); Reyna, L.G. Los Alamos National Lab., NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940877–1: 3. Argentine and Latin American tribology conference and exhibition, Buenos Aires (Argentina), 8-12 Aug 1994). Order Number DE94011716. Source: OSTI; NTIS; GPO Dep.

In the hard disk magnetic recording technology, the slider carrying the magnetic elements is supported above the magnetic disk by a self-acting air bearing, which produces the load support. A lubricating film must support a required load with suitably small frictional energy losses and without introducing undesirable instabilities. Under submicron clearance conditions, gas film flow can not be described with continuum models since the molecular mean free path is not negligible compared with the clearance. Accurate results for the load-carrying capacity of gas films for arbitrary Knudsen number are very important since they strongly influence the design of the flying head slider and, consequently, the performance of the magnetic disk storage unit. Here we generalize the previous lubrication equations for arbitrary Knudsen number, accommodation coefficient and a small inclination of the slider relative to the magnetic disk surface.

23313 (LA-UR–94-1297) **Fuzzy logic to improve efficiency of finite element and finite difference schemes.** Garcia, M.D. (Los Alamos National Lab., NM (United States)); Heger, A.S. Los Alamos National Lab., NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-940859–18: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94011718. Source: OSTI; NTIS; GPO Dep.

This paper explores possible applications of logic in the areas of finite element and finite difference methods applied to engineering design problems. The application of fuzzy logic to both front-end selection of computational options and within the numerical computation itself are proposed. Further, possible methods of overcoming these limitations through the application of methods are explored. Decision strategy is a fundamental limitation in performing finite element calculations, such as selecting the optimum coarseness of the grid, numerical integration algorithm, element type, implicit versus explicit schemes, and the like. This is particularly true of novice analysts who are confronted with a myriad of choices in performing a calculation. The advantage of having the myriad of options available to the analyst is, however, that it improves and optimizes the design process if the appropriate ones are selected. Unfortunately, the optimum choices are not always apparent and only through the process of elimination or prior extensive experience can the optimum choices or combination of choices be selected. The knowledge of expert analysts could be integrated into a fuzzy "front-end" rule-based package to optimize the design process. The use of logic to capture the heuristic and human knowledge for selecting optimum solution strategies sets the framework for these proposed strategies.

23314 (LBL–35158) **Recovering depth from focus using iterative image estimation techniques.** Vitria, J.; Llacer, J. Lawrence Berkeley Lab., CA (United States). Sep 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE94010994. Source: OSTI; NTIS; GPO Dep.

In this report we examine the possibility of using linear and nonlinear image estimation techniques to build a depth map of a three dimensional scene from a sequence of partially focused images. In particular, the techniques proposed to solve the problem of construction of a depth map are: (1) linear methods based on regularization procedures and (2) nonlinear methods based on statistical modeling. In the first case, we have implemented a matrix-oriented method to recover the point spread function (PSF) of a sequence of partially defocused images. In the second case, the chosen method has been a procedure based on image estimation by means of the EM algorithm, a well known technique in image reconstruction in medical applications. This method has been generalized to deal with optically defocused image sequences.

23315 (LBL–35166) **Overview of medium heterogeneity and transport processes.** Tsang, Y.; Tsang, C.F. Lawrence Berkeley Lab., CA (United States). Nov 1993. 9p. Sponsored by USDOE, Washington, DC (United States);Energiverken, Goeteborg (Sweden). Energifoersoerjningsdelegationen. DOE Contract AC03-76SF00098. (CONF-9311199–1: International workshop on research and development of geological disposal, Tokai (Japan), 15-19 Nov 1993). Order Number DE94011356. Source: OSTI; NTIS; INIS; GPO Dep.

Medium heterogeneity can have significant impact on the behavior of solute transport. Tracer breakthrough curves from transport in a heterogeneous medium are distinctly different from that in a homogeneous porous medium. Usually the shape of the breakthrough curves are highly non-symmetrical with a fast rise at early times and very long tail at late times, and often, they consist of multiple peaks. Moreover, unlike transport in a homogeneous medium where the same transport parameters describe the entire medium, transport through heterogeneous media gives rise to breakthrough curves which have strong spatial dependence. These inherent characteristics of transport in heterogeneous medium present special challenge to the performance assessment of a potential high level nuclear waste repository with respect to the possible release of radio nuclides to the accessible environment. Since an inherently desirable site characteristic for a waste repository is that flow and transport should be slow, then transport measurements in site characterization efforts will necessarily be spatially small and temporally short compare to the scales which are of relevance to performance assessment predictions. In this paper we discuss the role of medium heterogeneity in site characterization and performance assessment. Our discussion will be based on a specific example of a 3D heterogeneous stochastic model of a site generally similar to, the Aespoe Island, the site of the Hard Rock Laboratory in Southern Sweden. For our study, alternative 3D stochastic fields of hydraulic conductivities conditioned on "point" measurements shall be generated. Results of stochastic flow and transport simulations would be used to address the issues of (1) the relationship of tracer breakthrough with the structure of heterogeneity, and (2) the inference from small scale testing results to large scale and long term predictions.

23316 (ORNL/FTR–4880) **Travel to England for a meeting of the Fossil Fuel Era Working Group of the International Geosphere-Biosphere Program: Foreign trip report, December 11–17, 1993.** Emanuel, W.R. Oak Ridge National Lab., TN (United States). 31 Dec 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94004870. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The International Geosphere-Biosphere Program's Task Force for Global Analysis, Interpretation, and Modeling seeks to improve models of the global biogeochemical cycles that control atmospheric greenhouse gas concentrations. As part of this effort, the Fossil Fuel Era Working Group is assembling terrestrial ecosystem process models that more realistically represent carbon and nitrogen cycling in ecosystems on land. The Working Group met at the University of Sheffield to modify photosynthesis and plant productivity models so that they can be incorporated into a global terrestrial carbon cycling model. The group completed the required modifications and used the model to simulate the global distribution of leaf area index and net primary productivity under natural conditions.

23317 (ORNL/TM–12686) **A method for obtaining a least squares fit of a hyperplane to uncertain data.** Reister, D.B.; Morris, M.D. Oak Ridge National Lab., TN (United States). May 1994. 16p. Sponsored by USDOE, Washington, DC (United States);Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012498. Source: OSTI; NTIS; GPO Dep.

For many least squares problems, the uncertainty is in one of the variables [for example, $y = f(x)$ or $z = f(x,y)$]. However, for some problems, the uncertainty is in the geometric transformation from measured data to Cartesian coordinates and all of the calculated variables are uncertain. When we seek the best least squares fit of a hyperplane to the data, we obtain an over determined system (we have $n + 1$ equations to determine n unknowns). By neglecting one of the equations at a time, we can obtain $n + 1$ different solutions for the unknown parameters. However, we cannot average the $n + 1$ hyperplanes to obtain a single best estimate. To obtain a solution without neglecting any of the equations, we solve an eigenvalue problem and use the eigenvector associated with the smallest eigenvalue to determine the unknown parameters. We have performed numerical experiments that compare our eigenvalue method to the approach of neglecting one equation at a time.

23318 (PNL–9794) **The estimation of parameters in nonlinear, implicit measurement error models with experiment-wide measurements.** Anderson, K.K. Pacific Northwest Lab., Richland, WA (United States). May 1994. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE94012759. Source: OSTI; NTIS; GPO Dep.

Measurement error modeling is a statistical approach to the estimation of unknown model parameters which takes into account the measurement errors in all of the data. Approaches which ignore the measurement errors in so-called independent variables may yield inferior estimates of unknown model parameters. At the same time, experiment-wide variables (such as physical constants) are often treated as known without error, when in fact they were produced from prior experiments. Realistic assessments of the associated uncertainties in the experiment-wide variables can be utilized to improve the estimation of unknown model parameters. A maximum likelihood approach to incorporate measurements of experiment-wide variables and their associated uncertainties is presented here. An iterative algorithm is presented which yields estimates of unknown model parameters and their estimated covariance matrix. Further, the algorithm can be used to assess the sensitivity of the estimates and their estimated covariance matrix to the given experiment-wide variables and their associated uncertainties.

23319 (SAND–93-3834) **ETPRE User's Manual Version 3.00.** Roginski, R.J. Sandia National Labs., Albuquerque, NM (United States). May 1994. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94012582. Source: OSTI; NTIS; GPO Dep.

ETPRE is a preprocessor for the Event Progression Analysis Code EVNTRE. It reads an input file of event definitions and writes the lengthy EVNTRE code input files. ETPRE's advantage is that it eliminates the error-prone task of manually creating or revising these files since their formats are quite elaborate. The user-friendly format of ETPRE differs from the EVNTRE code format in that questions, branch references, and other event tree components are defined symbolically instead of numerically. When ETPRE is executed, these symbols are converted to their numeric equivalents and written to the output files using formats defined in the EVNTRE Reference Manual. Revisions to event tree models are simplified by allowing the user to edit the symbolic format and rerun the preprocessor, since questions, branch references, and other symbols are automatically resequenced to their new values with each execution. ETPRE and EVNTRE have both been incorporated into the SETAC event tree analysis package.

23320 (SAND–94-0296C) **Bootstrap planning: Theory and application.** Chen, P.C. Sandia National Labs., Albuquerque, NM (United States). [1994]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940860–1: 12. national conference on artificial intelligence, Seattle, WA (United States), 1 Aug 1994). Order Number DE94006466. Source: OSTI; NTIS; GPO Dep.

We identify a general framework for weak planning called bootstrap planning, which is defined as global planning using only a local planner along with some memory for learning intermediate subgoals. We present a family of algorithms for bootstrap planning, and provide some initial theory on their performance. In our theoretical analysis, we develop a random digraph problem model and use it to make some performance predictions and comparisons of these algorithms. We also use it to provide some techniques for approximating the optimal resource bound on the local planner to achieve the best global planner. We validate our theoretical results with empirical demonstration on the 15-puzzle. We show how to reduce the planning cost of a global planner by 2 orders of magnitude using bootstrap planning. We also demonstrate a natural but not widely recognized connection between search costs and the lognormal distribution.

23321 (SAND–94-0596C) **Remote use of distributed robotics resources to enhance technology development and insertion.** Harrigan, R.W.; McDonald, M.J.; Davies, B.R. Sandia National Labs., Albuquerque, NM (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–14: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94009285. Source: OSTI; NTIS; GPO Dep.

This paper describes Virtual Collaborative Environments (VCEs), an information architecture that enables remote sharing of mechatronic (intelligent electrochemical devices) resources. This architecture will leverage the proposed National Information Infrastructure (NII) or Information Highway to share valuable resources and reduce product-to-market cycles. Benefits of sharing mechatronic resources with VCEs are explored. An existing prototype VCE is described and experimental and illustrative results from using the prototype VCE system are discussed.

23322 (SAND–94-0734C) **Interactive Collaborative Environments (ICE): Platform independent X application sharing and multi-media over wide area networks.** Ashby, M.R.; Lin, H.W. Sandia National Labs., Albuquerque, NM (United States). 1994. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940859–9: 5. international symposium on robotics and manufacturing, Maui, HI (United States), 14-18 Aug 1994). Order Number DE94008868. Source: OSTI; NTIS; GPO Dep.

Platform-independent Interaction Collaborative Environments (ICE) technologies include support for simultaneous display and control of unmodified X application software by two or more people, at separate locations, using different workstation hardware. Audio and video provide remote collaborators with the ability to discuss what they are all simultaneously seeing on their workstations. Remote pointing and marking capabilities are also provided independent of the application. The authors briefly describe their X application sharing work, and requirements for supporting tools, including multi-media. Finally they review some of the pilot project network applications of their work to robotics and manufacturing environments.

23323 (SAND–94-0921C) **Customer needs questionnaire.** Shirley, K.W.; Spencer, A.C. Sandia National Labs., Albuquerque, NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9405131–1: 45. international industrial engineering conference, Atlanta, GA (United States), 15-18 May 1994). Order Number DE94010394. Source: OSTI; NTIS; GPO Dep.

The effectiveness of a survey distributed among a statistical sample of personnel at Sandia National Laboratories is examined. The Facilities Quality Program Office (FQPO) effort is part of the total quality management approach underway at Sandia. A rudimentary analysis of the survey is presented.

23324 (SAND–94-1015C) **Recent enhancements to probabilistic risk assessment software at Sandia National Laboratories.** Wyss, G.D.; Daniel, S.L. Sandia National Labs., Albuquerque, NM (United States). [1994]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9406159–1: Integrated risk management: working toward a common process workshop, Albuquerque, NM (United States), 8-10 Jun 1994). Order Number DE94010759. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. RISK ASSESSMENT/computer codes; PROBABILISTIC ESTIMATION; E CODES; S CODES; T CODES; L CODES; FAULT TREE ANALYSIS; PERSONAL COMPUTERS

23325 (SAND–94-1046C) **Cardinality bounds for triangulations with bounded minimum angle.** Mitchell, S.A. Sandia National Labs., Albuquerque, NM (United States). [1994]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-940887–1: 5. Canadian conference on computational geometry, Saskatoon (Canada), 2-6 Aug 1994). Order Number DE94010692. Source: OSTI; NTIS; GPO Dep.

We consider bounding the cardinality of an arbitrary triangulation with smallest angle α. We show that if the local feature size (i.e. distance between disjoint vertices or edges) of the triangulation is within a constant factor of the local feature size of the input, then $N < O(1/\alpha)M$, where N is the cardinality of the triangulation and M is the cardinality of any other triangulation with smallest angle at least α. Previous results had an $O(1/\alpha^{1/\alpha})$ dependence. Our $O(1/\alpha)$ dependence is tight for input with a large length to height ratio, in which triangles may be oriented along the long dimension.

23326 (SAND–94-1477C) **Parallel performance of a preconditioned CG solver for unstructured finite element applications.** Shadid, J.N.; Hutchinson, S.A.; Moffat, H.K. Sandia National Labs., Albuquerque, NM (United States). [1994]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. (CONF-9404103–2: Colorado conference on iterative methods, Breckenridge, CO (United States), 4-10 Apr 1994). Order Number DE94013772. Source: OSTI; NTIS; GPO Dep.

A parallel unstructured finite element (FE) implementation designed for message passing machines is described. This implementation employs automated problem partitioning algorithms for load balancing unstructured grids, a distributed sparse matrix representation of the global finite element equations and a parallel conjugate gradient (CG) solver. In this paper a number of issues related to the efficient implementation of parallel unstructured mesh applications are presented. These include the differences between structured and unstructured mesh parallel applications, major communication kernels for unstructured CG solvers, automatic mesh partitioning algorithms, and the influence of mesh. partitioning metrics on parallel performance. Initial results are presented for example finite element (FE) heat transfer analysis applications on a 1024 processor nCUBE 2 hypercube. Results indicate over 95%

scaled efficiencies are obtained for some large problems despite the required unstructured data communication.

23327 (SAND–94-1547) **ATM-test: A workstation-based software suite for testing asynchronous transfer mode (ATM) networks.** Tarman, T.D. Sandia National Labs., Albuquerque, NM (United States). Jun 1994. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013813. Source: OSTI; NTIS; GPO Dep.

The design of a software package that provides a variety of Asynchronous Transfer Mode (ATM) test functions is presented here. These functions include cell capture, protocol decode for Transmission Control Protocol/Internet Protocol (TCP/IP) services, removal of cells (to support testing of an ATM system under cell loss conditions), and echo functions. This package is currently written to operate on the Sun Microsystems SPARCstation 10/SunOS 4.1.3 environment with a Fore Systems SBA-100 Sbus ATM adapter (140 Mbit/s TAXI interface), and the DEC 5000/240 running ULTRIX 4.2A with a Fore Systems TCA-100 TurboChannel adapter. Application scenarios and performance measurements of this software package on these host environments are presented here.

23328 (UCRL-CR–115793) **Application of multiquadric method for numerical solution of elliptic partial differential equations.** Sharan, M. (Indian Inst. of Tech., New Delhi (India)); Kansa, E.J.; Gupta, S. Lawrence Livermore National Lab., CA (United States). Jan 1994. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94012999. Source: OSTI; NTIS; GPO Dep.

We have used the multiquadric (MQ) approximation scheme for the solution of elliptic partial differential equations with Dirichlet and/or Neumann boundary conditions. The scheme has the advantage to use the data points in arbitrary locations with an arbitrary ordering. Two dimensional Laplace, Poisson and Biharmonic equations describing the various physical processes, have been taken as the test examples. The agreement is found to be very good between the computed and exact solutions. The method also provides an excellent approximation with curve boundary.

23329 (UCRL-CR–116109-Summ.) **Multiquadric collocation methods in the numerical solution of Volterra integral equations with weakly singular kernels.** Makroglou, A. (Univ. of Manchester (United Kingdom)); Kansa, E.J. Lawrence Livermore National Lab., CA (United States). Dec 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94013000. Source: OSTI; NTIS; GPO Dep.

Nonlinear Volterra integral equation with weakly singular kernels are considered and are solved by applying piecewise collocation methods based on multiquadric approximations combined with Gauss quadrature rules.

23330 (UCRL-MI–113637) **Computer Security Awareness Guide for Department of Energy Laboratories, Government Agencies, and others for use with Lawrence Livermore National Laboratory's (LLNL): Computer security short subjects videos.** Lawrence Livermore National Lab., CA (United States). [1993]. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE94013462. Source: OSTI; NTIS; GPO Dep.

Lonnie Moore, the Computer Security Manager, CSSM/CPPM at Lawrence Livermore National Laboratory (LLNL) and Gale Warshawsky, the Coordinator for Computer Security Education & Awareness at LLNL, wanted to share topics such as computer ethics, software piracy, privacy issues, and protecting information in a format that would capture and hold an audience's attention. Four Computer Security Short Subject videos were produced which ranged from 1-3 minutes each. These videos are very effective education and awareness tools that can be used to generate discussions about computer security concerns and good computing practices. Leaders may incorporate the Short Subjects into presentations. After talking about a subject area, one of the Short Subjects may be shown to highlight that subject matter. Another method for sharing them could be to show a Short Subject first and then lead a discussion about its topic. The cast of characters and a bit of information about their personalities in the LLNL Computer Security Short Subjects is included in this report.

23331 (WSRC-IM–90-83-14) **Reviews of computing technology: Software overview.** Hartshorn, W.R.; Johnson, A.L. Westinghouse Savannah River Co., Aiken, SC (United States). 5 Jan 1994. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE94013662. Source: OSTI; NTIS; GPO Dep.

The Savannah River Site Computing Architecture states that the site computing environment will be standards-based, data-driven, and workstation-oriented. Larger server systems deliver needed information to users in a client-server relationship. Goals of the Architecture include utilizing computing resources effectively, maintaining a high level of data integrity, developing a robust infrastructure, and storing data in such a way as to promote accessibility and usability. This document describes the current storage environment at Savannah River Site (SRS) and presents some of the problems that will be faced and strategies that are planned over the next few years.

9903 Information Handling

Refer also to citation(s) 20749, 20779, 20870, 21028, 21712, 21924, 22437, 22558, 22559, 22717, 22943, 23262

23332 (ANL/TD/CP–82680) **A graphic view of Geometric Dimensioning and Tolerancing.** Swanson, R.A.C. Argonne National Lab., IL (United States). [1994]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE94011478. Source: OSTI; NTIS; GPO Dep.

This paper points out a weakness frequently encountered in communication between Engineering Documents and Manufacturing Practices. In addition this paper gives an overview of a symbolic language designed to provide important communication between the Engineering Document and the Manufacturing process for every part and assembly. It will define the application of the characters used. Unlike the English language where the same word can have several meanings, the characters used in this symbolic language have only one.

23333 (CNIC–00755) **A base to standardize data processing of cadmium ratio R_{Cd} and thermal neutron flux measurements on reactor.** Li Zhaohuan (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). China Nuclear Information Centre, Beijing, BJ (China). Aug 1993. 21p. (IAE–0118.). Order Number DE94626619. Source: OSTI; NTIS (US Sales Only); INIS.

The cadmium ratio R_{Cd} and thermal neutron flux are usually measured in a reactor. But its data process is rather complex. The results from same measured data differ by different existing process methods. The purpose of this work is to standardize data processing in R_{Cd} and thermal neutron flux measurements. A natural choice for this purpose is to derive a R_{Cd} formula based on standard average thermal activation cross section and resonance integral and to define related parameters or factors that provide an unique base for comparison between different measurements in laboratories. The parameters or factors include E_c, F_m, F_m' and G_{th}' in thermal energy region due to upper truncated Maxwellian distribution and E_{Cd}, F_{Cd}, G_r and S_r in intermediate energy region. They are the function of multiple variables. The Au foil is used as an example to demonstrate their behaviors by chosen figures and tables which provide for practical data process by hand. The work also discusses limitation of R_{Cd} measurement in terms of so called available and optimum region and notes that Co and Mn foils have a much wider available region among Au, In, Mn, W and Co, the commonly used detector foils.

23334 (CONF-9406178–1) **The emergence of Electronic Democracy as an auxiliary to representational democracy.** Noel, R.E. Oak Ridge National Lab., TN (United States). [1994]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 38. annual meeting of the International Society for System Sciences; Pacific Grove, CA (United States); 13-19 Jun 1994. Order Number DE94013272. Source: OSTI; NTIS; GPO Dep.

Electronic democracy as a system is defined, and the ways in which it may affect current systems of government is addressed. Electronic democracy's achievements thus far in the United States at the community level are surveyed, and prospects for its expansion to state, national, and international systems are summarized. Central problems of electronic democracy are described, and its feasibility assessed (including safeguards against, and vulnerabilities to sabotage and abuse); the ways in which new and ongoing methods for information dissemination pose risks to current systems of government are discussed. One of electronic democracy's underlying assumptions is challenged, namely that its direct, instant polling capability necessarily improves or refines governance. Further support is offered for the assertion that computer systems/networks should be used primarily to educate citizens and enhance awareness of issues, rather than as frameworks for direct decision making.

23335 (DOE/EIA–0205(94)) **Energy information directory 1994.** National Energy Information Center, Washington, DC (United States). 28 Mar 1994. 111p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94009431. Source: OSTI; NTIS; GPO Dep.

The National Energy Information Center (NEIC), as part of its mission, provides energy information and referral assistance to Federal, State, and local governments, the academic community, business and industrial organizations, and the general public. The two principal functions related to this task are (1) operating a general access telephone line, and (2) responding to energy-related correspondence addressed to the Energy Information Administration (EIA). The Energy Information Directory was developed to assist the NEIC staff, as well as other Department of Energy (DOE) staff, in directing inquiries to the proper offices within DOE, other Federal agencies, or energy-related trade associations. The Directory is a list of most Government offices and trade associations that are involved in energy matters. It does not include those DOE offices which do not deal with the public or public information.

23336 (DOE/ER/30153–T1) **Database use and technology in Japan: JTEC panel report: Final report.** Wiederhold, G.; Beech, D.; Bourne, C.; Farmer, N.; Jajodia, Sushil; Kahaner, D.; Minoura, Toshi; Smith, D.; Smith, J.M. Loyola Coll., Baltimore, MD (United States). Japanese Technology Evaluation Center. Apr 1992. 131p. Sponsored by USDOE, Washington, DC (United States);National Science Foundation, Washington, DC (United States). DOE Contract AI05-89ER30153. Grant ECS-8922947. Order Number DE94012795. Source: OSTI; NTIS; GPO Dep.

This report presents the findings of a group of database experts, sponsored by the Japanese Technology Evaluation Center (JTEC), based on an intensive study trip to Japan during March 1991. Academic, industrial, and governmental sites were visited. The primary findings are that Japan is supporting its academic research establishment poorly, that industry is making progress in key areas, and that both academic and industrial researchers are well aware of current domestic and foreign technology. Information sharing between industry and academia is effectively supported by governmental sponsorship of joint planning and review activities, and enhances technology transfer. In two key areas, multimedia and object-oriented databases, the authors can expect to see future export of Japanese database products, typically integrated into larger systems. Support for academic research is relatively modest. Nevertheless, the senior faculty are well-known and respected, and communicate frequently and in depth with each other, with government agencies, and with industry. In 1988 there were a total of 1,717 Ph.D.'s in engineering and 881 in science. It appears that only about 30 of these were academic Ph.D.'s in the basic computer sciences.

23337 (DOE/FTR–94004500) **Travel to Sweden to participate in the on-going creation of the new high-speed computer networking standard Asynchronous Transfer Mode: Foreign trip report, 14 November 1993–21 November 1993.** Chen, H.Y. Sandia National Labs., Livermore, CA (United States). 20 Dec 1993. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94004500. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The ATM forum is progressing toward defining a workable standard for use of tomorrow's ATM networks. Helen Chen presented "Simulation Results of TCP Performance over ATM with and without flow control" to the Traffic Management subgroup. Many people from companies with proposed flow-control schemes expressed a desire to collaborate with Sandia in studying these flow-control schemes. The Email document distribution system employed for this meeting was unanimously felt inadequate and an alternative voted in; the new system will use an FTP server with two printed copies provided to each Principal Member.

23338 (INIS-JP–018, pp. 1069-1075) **The IAEA's role in international information exchange.** Brittinger, M.T.M. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Safety); Selling, H.A. 1993. 1709p. (CONF-920905–: PATRAM '92: 10th international symposium on the packaging and transportation of radioactive materials, Yokohama (Japan), 13-18 Sep 1992). In *The 10th international symposium on the packaging and transportation of radioactive materials: Proceedings.* Order Number DE94737964. Source: OSTI; NTIS; INIS.

Composed of three volumes.

The International Atomic Energy Agency strives to foster the exchange of scientific and technical information in the transport safety area through a dual work programme covering the development and maintenance of the Regulations for the Safe Transport of Radioactive Material, on the one hand, and their implementation, on the other. Under the implementation aspect of its transport safety programme the IAEA takes advantage of the increased availability of mass storage media and the equipment to access them to use databases for information exchange. Information is collected on the identification of national competent authorities, package approval certificates, events in radioactive material transport, research and development, shipments, and exposure data. Data on national competent authorities and the package approval certificates that they issue is updated and disseminated annually to all Member States. Research in progress is described in a document that is published every two years. Databases on events, shipments and radiation exposure are in the development phase. Member States experience difficulty in obtaining the appropriate information and thus, the reporting periods for these subject areas are extended. Information gathered through these activities serve as regulatory aids to the national competent authorities responsible in the Member States for the transport of radioactive material, both internationally and nationally. In addition, it is useful in support of the continuous review and revision process of the transport Regulations and their supporting documents. (J.P.N.).

23339 (ORNL/TM–12725) **Database specification for the Worldwide Port System (WPS) Regional Integrated Cargo Database (ICDB).** Faby, E.Z. (Univ. of Tennessee, Knoxville, TN (United States)); Fluker, J.; Hancock, B.R.; Grubb, J.W.; Russell, D.L.; Loftis, J.P.; Shipe, P.C.; Truett, L.F. Oak Ridge National Lab., TN (United States). Mar 1994. 249p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE94012497. Source: OSTI; NTIS; GPO Dep.

This Database Specification for the Worldwide Port System (WPS) Regional Integrated Cargo Database (ICDB) describes the database organization and storage allocation, provides the detailed data model of the logical and physical designs, and provides information for the construction of parts of the database such as tables, data elements, and associated dictionaries and diagrams.

23340 (PNL-SA–23921) **Building a Collaboratory in Environmental and Molecular Science.** Kouzes, R.T.; Myers, J.D.; Devaney, D.M.; Dunning, T.H.; Wise, J.A. Pacific Northwest Lab., Richland, WA (United States). Mar 1994. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9403113–1: Environmental and molecular sciences collaboratory conference, Richland, WA (United States), 17-19 Mar 1994). Order Number DE94011439. Source: OSTI; NTIS; INIS; GPO Dep.

A Collaboratory is a meta-laboratory that spans multiple geographical areas with collaborators interacting via electronic means. Collaboratories are designed to enable close ties between scientists in a given research area, promote collaborations involving

scientists in diverse areas, accelerate the development and dissemination of basic knowledge, and minimize the time-lag between discovery and application. PNL is developing the concept of an Environmental and Molecular Sciences Collaboratory (EMSC) as a natural evolution of the EMSL project. The goal of the EMSC is to increase the efficiency of research and reduce the time required to implement new environmental remediation and preservation technologies. The EMSC will leverage the resources (intellectual and physical) of the EMSL by making them more accessible to remote collaborators as well as by making the resources of remote sites available to local researchers. It will provide a common set of computer hardware and software tools to support remote collaboration, a key step in establishing a collaborative culture for scientists in the theoretical, computational, and experimental molecular sciences across the nation. In short, the EMSC will establish and support an 'electronic community of scientists researching and developing innovative environmental preservation and restoration technologies.

23341 (SAND–94-0460) **An annotated summary of the Information Model Design Procedure (IMDP).** Becker, S.D. Sandia National Labs., Albuquerque, NM (United States). May 1994. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-94AL85000. Order Number DE94013458. Source: OSTI; NTIS; GPO Dep.

This presentation documents the essential elements of the IMDP as applied at Sandia National Laboratories/New Mexico. The IMDP is an adaptation of the Natural-Language Information Analysis Methodology (NIAM) of G. M. Nijssen. The underlying purpose of both of these methodologies is to provide a formal, reproducible, and verifiable approach to specifying the information requirements of an information system. The IMDP spans the specification process from initial scoping; through verbalization of problem-domain facts, specification of constraints, and subtype analysis; and finally to application of a formal algorithm for developing a fifth-normal-form relational database design.

9904 Law

Refer also to citation(s) 22651

23342 (DOE/EIA–0563) **Public Utility Holding Company Act of 1935: 1935–1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of the Administrator. 15 Jan 1993. 78p. Sponsored by USDOE, Washington, DC (United States). Order Number DE94008251. Source: OSTI; NTIS; GPO Dep.

This report provides an economic and legislative history and analysis of the Public Utilities Holding Company Act (PUHCA) of 1935. This Act was substantially amended for the first time in 1992 by passage of the Energy Policy Act (EPACT). The report also includes a discussion of the issues which led to the amendment of PUHCA and projections of the impact of these changes on the electric industry. The report should be of use to Federal and State regulators, trade associations, electric utilities, independent power producers, as well as decision-makers in Congress and the Administration.

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in ETDE/PUB–3 (Rev.1), *International Energy: Research Organizations 1988–1992*. Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, indicated by International Organization for Standardization (ISO) country code; and (3) the language of the document if non-English (R;CA;In French). Author affiliations are not listed in this index.

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	19:19594	EGG-WM–11066
	19:19595	EGG-WM–11205
	19:19596	EGG-WMO–10279-Vol.2
	19:20229	EGG-FSP–10960
	19:20432	EGG–2723
	19:20433	EGG-FSP–11109
	Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications	
	19:18091	NUREG/CR–6070
	Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research	
	19:18489	NUREG/CR–6200
	19:18516	NUREG/CR–6160
	19:18517	NUREG/CR–6196
AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States)**	
	19:18259	WINCO–1201
	19:19497	PATENTS-US–A7868149

Contract No.	Abstract No.	Report No.
AC07-93ID13215	**Coleman Energy and Environmental Systems, Golden, CO (United States). Blackhawk Geosciences Div.**	
	19:18025	DOE/ID/13215–T2
	19:19915	DOE/ID/13215–T2-Attach.
AC08-88NV10617	**EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab.**	
	19:19535	EGG–10617-1192
AC08-89NV10630	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States)**	
	19:19532	DOE/NV/10630–85
AC08-90NV10845	**Nevada Univ., Las Vegas, NV (United States). Desert Research Inst.**	
	19:18032	DOE/NV/10845–41
	Nevada Univ., Las Vegas, NV (United States). Water Resources Center	
	19:19586	DOE/NV/10845–20
AC08-93NV11265	**EG and G Energy Measurements, Inc., Las Vegas, NV (United States)**	
	19:18044	EGG–11265-2031
	19:19591	EGG–11265-2030
AC08-94NV11432	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States)**	
	19:18035	DOE/NV/11432–T3
	19:19281	DOE/NV/11432–1
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept.**	
	19:17953	DPW–55-104
	19:18643	DPW–54-19-4
	19:18644	DPW–54-688
	19:18645	DPW–55-108
	19:18646	DPW–55-154
	19:19051	SR/H–694
	Hanford Works, Richland, WA (United States)	
	19:18283	DPN–130
	19:18284	DPN–131
	19:18285	DPN–133
AC09-76SR00819	**Argonne National Lab., IL (United States)**	
	19:19524	ANL/ER/PP–74856
	Savannah River Ecology Lab., Aiken, SC (United States)	
	19:18190	SRO–819-24
	19:19664	SRO-NERP–22
	Westinghouse Savannah River Co., Aiken, SC (United States)	
	19:19637	WSRC-MS–93-421
AC09-89SR18035	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.**	
	19:18282	DP–1052
	Westinghouse Savannah River Co., Aiken, SC (United States)	
	19:18101	PATENTS-US–A7821653
	19:18166	WSRC-MS–93-198
	19:18167	WSRC-MS–93-485
	19:18168	WSRC-MS–93-562
	19:18169	WSRC-MS–93-563
	19:18170	WSRC-RD–92-07-Rev.2
	19:18171	WSRC-RP–93-1388
	19:18172	WSRC-RP–94-197
	19:18173	WSRC-TR–93-169-Rev.2
	19:18174	WSRC-TR–93-527
	19:18175	WSRC-TR–93-673
	19:18176	WSRC-TR–94-0091
	19:18177	WSRC-TR–94-0126
	19:18178	WSRC-TR–94-166
	19:18191	WSRC-MS–93-456
	19:18192	WSRC-RP–93-580
	19:18193	WSRC-TR–94-005
	19:18194	WSRC-TR–94-006
	19:18195	WSRC-TR–94-007
	19:18196	WSRC-TR–94-0194
	19:18260	WSRC-MS–93-277-Rev.1
	19:18261	WSRC-MS–93-474-Rev.1
	19:18262	WSRC-MS–93-615
	19:18593	SRT-MTS–945052
	19:18637	WSRC-OS–93-16
	19:18638	WSRC-TR–93-543
	19:18810	WSRC-MS–94-0131
	19:18854	WSRC-IM–93-17-5
	19:18855	WSRC-IM–93-17-14
	19:18856	WSRC-IM–93-017-16
	19:19110	WSRC-MS–93-551-Rev.1
	19:19158	WSRC-TR–94-0132
	19:19237	SRT-CMA–940005
	19:19244	WSRC-MS–94-0199
	19:19245	WSRC-TR–94-0155
	19:19291	WSRC-TR–93-511
	19:19574	WSRC-MS–93-502
	19:19575	WSRC-TR–94-076
	19:19611	PATENTS-US–A7841108
	19:19637	WSRC-MS–93-421
	19:19638	WSRC-MS–94-064
	19:19639	WSRC-MS–94-082
	19:19640	WSRC-RP–93-1545
	19:19641	WSRC-TR–93-392
	19:19642	WSRC-TR–93-399
	19:19643	WSRC-TR–93-400
	19:19644	WSRC-TR–93-565
	19:19645	WSRC-TR–93-575
	19:19646	WSRC-TR–93-671
	19:19647	WSRC-TR–94-016
	19:19648	WSRC-TR–94-0133
	19:19660	PATENTS-US–A7839540
	19:19667	WSRC-TR–93-656
	19:20227	WSRC-TR–92-372
	19:20228	WSRC-TR–94-022
	19:20475	WSRC-MS–93-282
AC11-93PN38195	**Westinghouse Electric Corp., West Mifflin, PA (United States). Bettis Atomic Power Lab.**	
	19:18583	WAPD-T–3030
AC21-86MC22118	**Radian Corp., Austin, TX (United States)**	
	19:17844	DOE/MC/22118–3733
AC21-86MC23165	**General Motors Corp., Indianapolis, IN (United States). Allison Gas Turbine Div.**	
	19:17886	DOE/MC/23165–94/C0257
AC21-87MC24116	**Coal Technology Corp., Bristol, VA (United States)**	
	19:17768	DOE/MC/24116–3097
	19:17769	DOE/MC/24116–3255
	19:17770	DOE/MC/24116–3267
	19:17771	DOE/MC/24116–3700
AC21-88MC23174	**General Electric Co., Erie, PA (United States)**	
	19:19001	DOE/MC/23174–94/C0332
	General Electric Co., Schenectady, NY (United States). Corporate Research and Development Center	
	19:17887	DOE/MC/23174–3672
AC21-89MC24193	**Argonne National Lab., IL (United States)**	
	19:19276	DOE/MC/24193–3500
	19:19277	DOE/MC/24193–3501
	19:19278	DOE/MC/24193–3503
	19:19279	DOE/MC/24193–3504
AC21-89MC26006	**Allied-Signal Aerospace Co., Torrance, CA (United States)**	
	19:18902	DOE/MC/26006–3734

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AC21-90MC27226	ARCTECH, Inc., Chantilly, VA (United States)	
	19:17773	DOE/MC/27226–3469
AC21-91MC28087	Stanford Univ., CA (United States). Dept. of Geophysics	
	19:17936	DOE/MC/28087–3724
AC21-92MC28133	Membrane Technology and Research, Inc., Menlo Park, CA (United States)	
	19:17938	DOE/MC/28133–94/C0336
AC21-92MC28138	ICF Resources, Inc., Fairfax, VA (United States)	
	19:17943	DOE/MC/28138–3714
AC21-92MC29103	Babcock and Wilcox Co., Alliance, OH (United States). Research Center	
	19:18027	DOE/MC/29103–3661
AC21-92MC29106	Coleman Research Corp., Columbia, MD (United States)	
	19:19916	DOE/MC/29106–3531
AC21-92MC29107	Delphi Research, Inc., Albuquerque, NM (United States)	
	19:18966	DOE/MC/29107–3701
AC21-92MC29113	Mechanical Technology, Inc., Latham, NY (United States)	
	19:19183	DOE/MC/29113–3689
AC21-92MC29119	UTD, Inc., Newington, VA (United States)	
	19:19495	DOE/MC/29119–3667
AC21-92MC29120	Vortec Corp., Collegeville, PA (United States)	
	19:18028	DOE/MC/29120–3498
AC22-87PC79812	UOP, Inc., Des Plaines, IL (United States)	
	19:17774	DOE/PC/79812–T16
AC22-87PC79818	UOP, Inc., Des Plaines, IL (United States)	
	19:17927	DOE/PC/79818–T9
AC22-88PC88653	Solmecs Ltd., Tel Aviv (Israel)	
	19:18899	DOE/PC/88653–T5
AC22-88PC88818	Hydrocarbon Research, Inc., Princeton, NJ (United States)	
	19:17775	DOE/PC/88818–T4
AC22-88PC88852	Babcock and Wilcox Co., Alliance, OH (United States)	
	19:20544	ESTSC–000614SPARC00
	19:20545	ESTSC–000614SPARC01
AC22-89PC88654	Combustion Engineering, Inc., Windsor, CT (United States)	
	19:17745	DOE/PC/88654–T7
AC22-89PC89868	Texas A and M Univ., College Station, TX (United States). Research Foundation	
	19:17776	DOE/PC/89868–T1
AC22-89PC89869	UOP, Inc., Des Plaines, IL (United States)	
	19:17777	DOE/PC/89869–T9
	19:17778	DOE/PC/89869–T10
	19:17779	DOE/PC/89869–T11
	19:17780	DOE/PC/89869–T12
	19:18332	DOE/PC/89869–T13
AC22-89PC89883	Consolidation Coal Co., Library, PA (United States). Research and Development Dept.	
	19:17781	DOE/PC/89883–89
AC22-90BC14650	Texas Univ., Austin, TX (United States). Center for Petroleum and Geosystems Engineering	
	19:17908	DOE/BC/14650–15
AC22-90BC14658	Oklahoma Univ., Norman, OK (United States). School of Petroleum and Geological Engineering	
	19:17909	DOE/BC/14658–9
AC22-90BC14659	Oklahoma Univ., Norman, OK (United States). School of Petroleum and Geological Engineering	
	19:17910	DOE/BC/14659–T6
	19:17911	DOE/BC/14659–T8
AC22-90BC14660	Texas Univ., Austin, TX (United States). Center for Petroleum and Geosystems Engineering	
	19:17912	DOE/BC/14660–11
AC22-90BC14663	Injectech, Inc., Ochelata, OK (United States)	
	19:17913	DOE/BC/14663–9
	19:17914	DOE/BC/14663–11
AC22-90PC90035	Oklahoma State Univ., Stillwater, OK (United States)	
	19:19133	DOE/PC/90035–T7
AC22-90PC90045	Texas A and M Univ., College Station, TX (United States). Kinetics, Catalysis, and Reaction Engineering Lab.	
	19:18334	DOE/PC/90045–T7
	19:18335	DOE/PC/90045–T9
AC22-90PC90051	Michigan Biotechnology Inst., Lansing, MI (United States)	
	19:17782	DOE/PC/90051–T12
AC22-90PC90055	UOP, Inc., Des Plaines, IL (United States)	
	19:17783	DOE/PC/90055–T12
AC22-90PC90167	Energy International Corp., Pittsburgh, PA (United States)	
	19:17862	DOE/PC/90167–T11
	19:17863	DOE/PC/90167–T12
	19:17864	DOE/PC/90167–T13
	19:17865	DOE/PC/90167–T14
AC22-90PC90178	Utah Univ., Salt Lake City, UT (United States)	
	19:19097	DOE/PC/90178–T8
AC22-90PC90361	North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center	
	19:18452	DOE/PC/90361–T13
AC22-91BC14655	Ikwuakolam Energy Co., Denver, CO (United States)	
	19:17906	DOE/BC/14655–8
AC22-91PC90042	UOP, Inc., Des Plaines, IL (United States)	
	19:18333	DOE/PC/90042–T5
AC22-91PC90046	Union Carbide Chemicals and Plastics Co., Inc., South Charleston, WV (United States). South Charleston Technical Center	
	19:19134	DOE/PC/90046–T9
AC22-91PC90180	Pittsburgh Univ., PA (United States). Dept. of Mechanical Engineering	
	19:20235	DOE/PC/90180–T10
AC22-91PC90181	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:19272	CONF-9309310–
AC22-91PC90185	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:19260	CONF-9309310–
AC22-91PC90364	ADA Technologies, Inc., Englewood, CO (United States)	
	19:18453	DOE/PC/90364–T7
	19:18454	DOE/PC/90364–T8
AC22-91PC91028	Arkansas Univ., Fayetteville, AR (United States)	
	19:18336	DOE/PC/91028–T13
AC22-91PC91030	Dow Corning Corp., Carrollton, KY (United States)	
	19:19137	DOE/PC/91030–T8
AC22-91PC91034	West Virginia Univ. Research Corp., Morgantown, WV (United States)	
	19:18337	DOE/PC/91034–T7
AC22-91PC91039	SRI International, Menlo Park, CA (United States)	
	19:17789	DOE/PC/91039–T8

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AC22-91PC91040	Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research	
	19:17790	DOE/PC/91040–32
AC22-91PC91042	Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering	
	19:17791	DOE/PC/91042–7
	19:17792	DOE/PC/91042–8
AC22-91PC91044	SRI International, Menlo Park, CA (United States)	
	19:17765	CONF-9309257–3
	SRI International, Menlo Park, CA (United States). Molecular Physics Lab.	
	19:17793	DOE/PC/91044–T2
	19:17794	DOE/PC/91044–T3
AC22-91PC91052	Hydrocarbon Research, Inc., Princeton, NJ (United States)	
	19:17796	DOE/PC/91052–9
AC22-91PC91055	Auburn Univ., AL (United States). Dept. of Chemical Engineering	
	19:17797	DOE/PC/91055–T6
AC22-91PC91056	Illinois Univ., Chicago, IL (United States)	
	19:17798	DOE/PC/91056–T4
AC22-91PC91057	UOP, Inc., Des Plaines, IL (United States)	
	19:17799	DOE/PC/91057–T7
AC22-91PC91058	Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research	
	19:17800	DOE/PC/91058–T7
	19:17831	DOE/PC/91058–T9
AC22-91PC91154	Foster Wheeler Development Corp., Livingston, NJ (United States)	
	19:18424	DOE/PC/91154–T7
AC22-91PC91161	Vortec Corp., Collegeville, PA (United States)	
	19:17893	DOE/PC/91161–T7-Rev.1
AC22-92PC91047	Viking Systems International, Inc., Pittsburgh, PA (United States)	
	19:17830	DOE/PC/91047–T5
AC22-92PC91050	Canadian Energy Development, Inc., Edmonton, AB (Canada)	
	19:17795	DOE/PC/91050–T6
AC22-92PC91155	United Technologies Research Center, East Hartford, CT (United States)	
	19:18425	DOE/PC/91155–T6
AC22-92PC91343	IGR Enterprises, Inc., Cleveland, OH (United States)	
	19:18458	DOE/PC/91343–T3
	19:18459	DOE/PC/91343–T4
AC22-92PC91344	SRI International, Menlo Park, CA (United States)	
	19:18460	DOE/PC/91344–T7
AC22-92PC91346	Carnegie-Mellon Univ., Pittsburgh, PA (United States). Center for Energy and Environmental Studies	
	19:18461	DOE/PC/91346–5
AC22-92PC92109	Altamira Instruments, Inc., Pittsburgh, PA (United States)	
	19:17941	DOE/PC/92109–T4
AC22-92PC92110	AMAX Research and Development Center, Golden, CO (United States)	
	19:18338	DOE/PC/92110–T5
AC22-92PC92113	Worcester Polytechnic Inst., MA (United States)	
	19:18339	DOE/PC/92113–T4
AC22-92PC92118	Engineering Resources, Inc., Fayetteville, AR (United States)	
	19:17806	DOE/PC/92118–T5
AC22-92PC92119	Geo-Microbial Technologies, Inc., Ochelata, OK (United States)	
	19:17807	DOE/PC/92119–T3
	19:17850	DOE/PC/92119–T4
AC22-92PC92121	Utah Univ., Salt Lake City, UT (United States). Dept. of Chemical and Fuels Engineering	
	19:17809	DOE/PC/92121–T5
AC22-92PC92149	CeraMem Corp., Waltham, MA (United States)	
	19:17811	DOE/PC/92149–T5
AC22-92PC92176	United Technologies Corp., East Hartford, CT (United States). Research Center	
	19:17836	DOE/PC/92176–T6
AC22-92PC92196	Advanced Fuel Research, Inc., East Hartford, CT (United States)	
	19:19003	DOE/PC/92196–T3
	19:19004	DOE/PC/92196–T4
AC22-92PC92205	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States)	
	19:17750	DOE/PC/92205–T5
AC22-92PC92208	AMAX Research and Development Center, Golden, CO (United States)	
	19:18426	DOE/PC/92208–T5
AC22-92PC92246	Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States)	
	19:17751	DOE/PC/92246–T3
AC22-93PC91029	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:17788	DOE/PC/91029–T1
AC22-93PC92114	Institute of Gas Technology, Chicago, IL (United States)	
	19:18340	DOE/PC/92114–T2
AC22-93PC92116	Delaware Univ., Newark, DE (United States)	
	19:19141	DOE/PC/92116–T2
AC22-93PC92120	Media and Process Technology, Inc., Pittsburgh, PA (United States)	
	19:17808	DOE/PC/92120–T3
AC22-93PC92147	Hydrocarbon Research, Inc., Princeton, NJ (United States)	
	19:17810	DOE/PC/92147–5
AC22-93PC92190	PSI Technology Co., Andover, MA (United States). PowerServe Div.	
	19:17749	DOE/PC/92190–T3
AC22-93PC92206	AMAX Research and Development Center, Golden, CO (United States)	
	19:17851	DOE/PC/92206–T3
	19:17852	DOE/PC/92206–T4
AC22-93PC92251	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:17837	DOE/PC/92251–T2
	19:17838	DOE/PC/92251–T3
	19:17839	DOE/PC/92251–T4
AC22-93PC93051	Pennsylvania State Univ., University Park, PA (United States). Coal and Organic Petrology Labs.	
	19:17840	DOE/PC/93051–T1
AC22-93PC93251	Battelle, Columbus, OH (United States)	
	19:18443	CONF-940632–11
AC34-90DP62349	EG and G Rocky Flats, Inc., Golden, CO (United States)	
	19:18116	RFP–4758
	19:18119	RFP–4835
	19:18243	RFP–4799
	EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant	
	19:17991	RFP–4829
	19:18117	RFP–4806
	19:18118	RFP–4807
	19:19624	RFP–4812
AC34-90RF62349	Dow Chemical U.S.A., Golden, CO (United States). Rocky Flats Div.	
	19:19565	RFP–4849

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	EG and G Rocky Flats, Inc., Golden, CO (United States)	
	19:18120	RFP-ADD–0029
	EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant	
	19:20498	RFP–4795
AC35-89ER40486	**Sandia National Labs., Albuquerque, NM (United States)**	
	19:20300	SAND–94-0776C
	Superconducting Super Collider Lab., Dallas, TX (United States)	
	19:19326	SSCL–663
	19:19327	SSCL-Preprint–538
	19:19340	SSCL–659
	19:19341	SSCL–661
	19:19402	SSCL–660
	19:19403	SSCL–662
	19:19404	SSCL–664
	19:19405	SSCL–665
	19:19406	SSCL–666
	19:19407	SSCL–667
	19:19408	SSCL–668
	19:19409	SSCL-Preprint–517-Rev.2
	19:19410	SSCL-SR–1238
	19:19628	SSCL-SR–1233
	19:20013	SSCL–597-Rev.1
	19:20539	ESTSC–000556AP00000
AC65-90WA06473	**Stone and Webster Management Consultants, Inc., Englewood, CO (United States)**	
	19:20549	ESTSC–000672IBMPC01
AI01-91CE50306	**National Aeronautics and Space Administration, Cleveland, OH (United States). Lewis Research Center**	
	19:19096	DOE/NASA–50306-4
AI05-86ER60388	**National Inst. of Standards and Technology, Gaithersburg, MD (United States)**	
	19:19445	DOE/ER/60388–T5
AI05-90ER30169	**National Science Foundation, Washington, DC (United States)**	
	19:18624	DOE/ER/30169–T1
AI05-91ER40616	**National Inst. of Standards and Technology, Gaithersburg, MD (United States)**	
	19:19294	DOE/ER/40616–T1
AI05-92OR22030	**Jet Propulsion Lab., Pasadena, CA (United States)**	
	19:18310	DOE/OR/22030–T2
AI79-91BP16570	**Washington Univ., Seattle, WA (United States). Center for Quantitative Science**	
	19:18345	DOE/BP/35885–4
AT21-92MC29257	**Geological Survey, Denver, CO (United States)**	
	19:17937	DOE/MC/29267–3655
	Geological Survey, Reston, VA (United States)	
	19:19917	DOE/MC/29267–3458
BI79-84BP17622	**Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR (United States). Dept. of Natural Resources**	
	19:18344	DOE/BP/17622–7
BI79-87BP35885	**Washington Univ., Seattle, WA (United States). Fisheries Research Inst.**	
	19:18346	DOE/BP/35885–5
	Washington Univ., Seattle, WA (United States). Center for Quantitative Science	
	19:18345	DOE/BP/35885–4
BI79-89BP01466	**Idaho Dept. of Fish and Game, Boise, ID (United States). Fisheries Research Section**	
	19:18342	DOE/BP/01466–2
BI79-89BP01483	**Washington State Dept. of Wildlife, Olympia, WA (United States)**	
	19:18343	DOE/BP/01483–3
FC01-94RW00286	**Council of State Governments, Lombard, IL (United States). Midwestern Office**	
	19:18042	DOE/RW/00286–3
FC04-82AL16257	**Jacobs Engineering Group, Inc., Albuquerque, NM (United States)**	
	19:18200	DOE/AL/62350–40F-Attach.2
	19:18201	DOE/AL/62350–40F-Attach.3-4
	19:18202	DOE/AL/62350–40F-Attach.3-App.A
FC07-91ID13074	**Kansas State Univ., Manhattan, KS (United States)**	
	19:19009	DOE/ID/13074–T11
FC08-90NV10872	**Nevada Univ., Las Vegas, NV (United States)**	
	19:18034	DOE/NV/10872–T108
	19:19280	DOE/NV/10872–T72
	19:20588	DOE/NV/10872–T105
	Nevada Univ., Las Vegas, NV (United States). Harry Reid Center for Environmental Studies	
	19:18184	DOE/NV/10872–T110
	19:19786	DOE/NV/10872–T94
	Nevada Univ., Las Vegas, NV (United States). Southwestern Social Science Research Center	
	19:18033	DOE/NV/10872–T103
FC09-88SR15199	**South Carolina Univ., Columbia, SC (United States). Inst. of Archaeology and Anthropology**	
	19:18628	DOE/SR/15199–18
	South Carolina Univ., Columbia, SC (United States). Savannah River Archaeological Research Program	
	19:18627	DOE/SR/15199–5
FC21-86MC10637	**North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center**	
	19:17827	DOE/MC/10637–3710
FC21-87MC24132	**American Electric Power Service Corp., Columbus, OH (United States)**	
	19:17888	DOE/MC/24132–94/C0335
	19:17889	DOE/MC/24132–3712
FC21-87MC24207	**National Research Center for Coal and Energy, Morgantown, WV (United States)**	
	19:19585	DOE/MC/24207–3532
FC21-90MC25140	**Southern Co. Services, Inc., Birmingham, AL (United States)**	
	19:18445	DOE/MC/25140–3555
FC21-91MC27221	**General Electric Co., Schenectady, NY (United States). Power Systems Lab.**	
	19:19002	DOE/MC/27221–94/C0243
FC21-91MC27364	**Midwest Power, Sioux City, IA (United States)**	
	19:17890	DOE/MC/27364–94/C0337
FC21-91MC28055	**Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center**	
	19:18903	DOE/MC/28055–94/C0334
FC21-91MC28060	**Dravo Lime Co., Pittsburgh, PA (United States)**	
	19:18965	DOE/MC/28060–3723

Contract No.	Abstract No.	Report No.
FC21-92MC28178	Institute of Gas Technology, Chicago, IL (United States)	
	19:17939	DOE/MC/28178–3698
FC21-92MC29061	Clemson Univ., SC (United States). Research Foundation	
	19:19293	DOE/MC/29061–94/C0269
FC21-92MC29237	Fuel Cell Engineering Corp., Danbury, CT (United States)	
	19:18904	DOE/MC/29237–94/C0248
FC21-93MC29444	Tampella Power Corp., Williamsport, PA (United States)	
	19:18423	DOE/MC/29444–3715
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States)	
	19:17907	NIPER–713
	19:17919	NIPER–691
	19:17922	NIPER–705
	19:17923	NIPER–710
	19:17924	NIPER–712
	19:17925	NIPER–720
	19:17926	NIPER–722
	19:18427	NIPER–689(Vol.1)
	19:18428	NIPER–689(Vol.2)
FC22-87PC79796	Energy and Environmental Research Corp., Irvine, CA (United States)	
	19:18447	DOE/PC/79796–T36
FC22-90PC89653	Southern Research Inst., Birmingham, AL (United States)	
	19:18448	DOE/PC/89653–T12
FC22-90PC89657	Passamaquoddy Technology, L.P., Portland, ME (United States)	
	19:18449	DOE/PC/89657–T3-Vol.2
FC22-91PC90547	Energy and Environmental Research Corp., Irvine, CA (United States)	
	19:18455	DOE/PC/90547–T14
FC22-91PC90548	LIFAC North America, Inc., Pittsburgh, PA (United States)	
	19:18456	DOE/PC/90548–T12
FC22-92PC92521	Southern Illinois Univ., Carbondale, IL (United States)	
	19:17812	DOE/PC/92521–T126
FC22-93PC92578	Missouri Univ., Columbia, MO (United States). Capsule Pipeline Research Center	
	19:17866	DOE/PC/92578–T1
	19:17867	DOE/PC/92578–T2
FG01-89CE34025	Midwest Research Inst., Kansas City, MO (United States)	
	19:19909	DOE/CE/34025–T12
FG01-91CE15489	Mobile Zone Associates, Nashville, TN (United States)	
	19:18962	DOE/CE/15489–T10
FG01-92CE15553	Southern California Research Corp., San Rafael, CA (United States)	
	19:17917	DOE/CE/15553–T5
FG01-92EW50625	Medical Univ. of South Carolina, Charleston, SC (United States)	
	19:19798	DOE/EW/50625–T15
FG02-83ER75103	Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences	
	19:18642	DOE/ER/75103–T1
FG02-84ER13242	Massachusetts Univ., Boston, MA (United States)	
	19:20102	DOE/ER/13242–10
FG02-84ER13299	Colorado State Univ., Fort Collins, CO (United States)	
	19:19128	DOE/ER/13299–10
FG02-86ER13515	Minnesota Univ., Minneapolis, MN (United States)	
	19:20232	DOE/ER/13515–9
FG02-86ER45229	Argonne National Lab., IL (United States)	
	19:19286	ANL/MSD/PP–77650
FG02-86ER60408	Argonne National Lab., IL (United States)	
	19:19811	ANL/BIM/PP–73350
FG02-87ER13808	Northwestern Univ., Evanston, IL (United States)	
	19:19159	DOE/ER/13808–6
FG02-87ER40370	Ohio Univ., Athens, OH (United States). Dept. of Physics and Astronomy	
	19:20115	DOE/ER/40370–6
FG02-88ER13876	Princeton Univ., NJ (United States)	
	19:19160	DOE/ER/13876–T1
FG02-88ER13909	Cornell Univ., Ithaca, NY (United States)	
	19:19679	DOE/ER/13909–4
FG02-88ER13927	Northwestern Univ., Evanston, IL (United States). Dept. of Engineering Sciences and Applied Mathematics	
	19:19583	DOE/ER/13927–6
FG02-88ER40413	Lawrence Berkeley Lab., CA (United States)	
	19:19471	LBL-PUB–5380
FG02-88ER40438	Wisconsin Univ., Madison, WI (United States)	
	19:19347	DOE/ER/40438–1
FG02-88ER45365	Northwestern Univ., Evanston, IL (United States)	
	19:19034	DOE/ER/45365–6
FG02-88ER60661	Argonne National Lab., IL (United States)	
	19:19812	ANL/BIM/PP–76541
FG02-88ER60675	Pacific Northwest Lab., Richland, WA (United States)	
	19:19688	PNL-SA–22964
FG02-88ER60699	Center for Genetic Engineering, Belgrade (Yugoslavia). Genome Structure Unit	
	19:19682	DOE/ER/60699–3
FG02-89ER14004	Ohio State Univ., Columbus, OH (United States). Dept. of Horticulture	
	19:18309	DOE/ER/14004–5
FG02-89ER14043	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:19261	CONF-9309310–
FG02-89ER14079	Colorado School of Mines, Golden, CO (United States). Center for Wave Phenomena	
	19:20534	DOE/ER/14079–30
FG02-90ER13027	Massachusetts Inst. of Tech., Cambridge, MA (United States)	
	19:18641	DOE/ER/13027–1-Vol.2
FG02-90ER14140	Washington Univ., St. Louis, MO (United States). Dept. of Systems Science and Mathematics	
	19:18963	DOE/ER/14140–T1
FG02-90ER61029	Clarkson Univ., Potsdam, NY (United States). Dept. of Chemistry	
	19:19584	DOE/ER/61029–16
FG02-91CE23810	National Inst. of Standards and Technology, Gaithersburg, MD (United States). Thermophysics Div.	
	19:19088	DOE/CE/23810–20A
	Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States)	
	19:18912	DOE/CE/23810–38E
	19:19091	DOE/CE/23810–40A
	19:19092	DOE/CE/23810–40B
	19:19528	DOE/CE/23810–25
	Imagination Resources, Inc., Dublin, OH (United States)	
	19:19090	DOE/CE/23810–38B
	Spauschus Associates, Inc., Stockbridge, GA (United States)	
	19:19089	DOE/CE/23810–20B

Contract No.	Abstract No.	Report No.
FG02-91ER14192	Massachusetts Univ., Amherst, MA (United States). Dept. of Chemical Engineering	
	19:19171	DOE/ER/14192–3
FG02-91ER40646	Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy	
	19:20043	DOE/ER/40646–4
FG02-91ER40664	Iowa Univ., Iowa City, IA (United States)	
	19:19444	DOE/ER/40664–T1
FG02-91ER40688	Argonne National Lab., IL (United States)	
	19:20056	ANL-HEP-PR–93-4
FG02-91ER45439	USDOE Pittsburgh Energy Technology Center, PA (United States)	
	19:19084	CONF-9309310–
FG02-91ER45456	Pennsylvania State Univ., University Park, PA (United States)	
	19:19068	DOE/ER/45456–3
FG02-91ER75642	SciTech, Inc., Aurora, IL (United States)	
	19:20479	DOE/ER/75642–T1
FG02-91ER81221	Brookhaven National Lab., Upton, NY (United States)	
	19:19932	BNL–49773
FG02-92ER14244	Brookhaven National Lab., Upton, NY (United States)	
	19:18466	BNL–49263
FG02-92ER14258	Pennsylvania State Univ., University Park, PA (United States). Dept. of Chemistry	
	19:19131	DOE/ER/14258–T1
FG02-92ER14261	State Univ. of New York, Stony Brook, NY (United States)	
	19:17918	DOE/ER/14261–2
FG02-92ER14268	Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science	
	19:19033	DOE/ER/14268–2
FG02-92ER20070	Purdue Research Foundation, Lafayette, IN (United States)	
	19:19681	DOE/ER/20070–1
FG02-92ER25119	Chicago Univ., IL (United States)	
	19:19275	DOE/ER/25119–2
FG02-92ER45475	Oak Ridge National Lab., TN (United States)	
	19:19087	CONF-940753–5
FG02-92ER61384	South Carolina Univ., Columbia, SC (United States). Dept. of Biological Sciences	
	19:19906	DOE/ER/61384–2
FG02-92ER61427	Michigan Univ., Ann Arbor, MI (United States)	
	19:19690	DOE/ER/61427–1
FG02-92ER81463	Spire Corp., Bedford, MA (United States)	
	19:19439	CONF-9309256–5
FG02-93ER61549	Atmospheric and Environmental Research, Inc., Cambridge, MA (United States)	
	19:19530	DOE/ER/61549–1
FG02-93ER61567	Cornell Univ., Ithaca, NY (United States)	
	19:19684	DOE/ER/61567–T1
FG02-93ER61571	Syracuse Univ., NY (United States)	
	19:19696	CONF-9308226–1
FG02-93ER61658	Memorial Sloan-Kettering Cancer Center, New York, NY (United States)	
	19:19700	DOE/ER/61658–1
FG03-84ER45157	Stanford Univ., CA (United States). Edward L. Ginzton Lab.	
	19:19288	DOE/ER/45157–T1
FG03-85ER13353	California Univ., Davis, CA (United States). Dept. of Plant Pathology	
	19:19677	DOE/ER/13353–T2
FG03-86ER40271	California Univ., Riverside, CA (United States)	
	19:20126	DOE/ER/40271–T4
FG03-88ER40420	California Univ., Los Angeles, CA (United States)	
	19:19948	DOE/ER/40420–T5
FG03-88ER40424	Lawrence Berkeley Lab., CA (United States)	
	19:19471	LBL-PUB–5380
FG03-90ER54081	General Atomics, San Diego, CA (United States)	
	19:20307	DOE/ER/54081–T1
FG03-92ER25117	Stanford Univ., CA (United States). Systems Optimization Lab.	
	19:20578	SOL–93-7
FG03-92SF19524	City Coll., New York, NY (United States)	
	19:20481	DOE/SF/19524–2
FG03-93ER14334	Texas Univ., Austin, TX (United States). Dept. of Chemistry	
	19:19132	DOE/ER/14334–T1
FG03-93ER40757	Texas Univ., Austin, TX (United States)	
	19:19925	DOE/ER/40757–015
	19:19926	DOE/ER/40757–29
FG03-93ER40772	Lawrence Berkeley Lab., CA (United States)	
	19:19471	LBL-PUB–5380
FG03-93ER61606	Colorado Univ., Boulder, CO (United States)	
	19:19694	DOE/ER/61606–1
FG03-94ER54241	Texas Univ., Austin, TX (United States). Fusion Research Center	
	19:20308	DOE/ER/54241–130
FG04-91AL65779	New Mexico Environment Dept., Santa Fe, NM (United States)	
	19:19527	DOE/AL/65779–1
FG05-84ER13191	Texas Univ., Austin, TX (United States). Dept. of Physics	
	19:20231	DOE/ER/13191–14
FG05-84ER40162	Georgia State Univ., Atlanta, GA (United States)	
	19:20125	DOE/ER/40162–T7
FG05-85ER13429	Rice Univ., Houston, TX (United States)	
	19:20234	DOE/ER/13429–8
FG05-85ER40200	Texas Univ., Austin, TX (United States)	
	19:19979	DOE/ER/40200–319
FG05-87ER13678	Oklahoma Univ., Norman, OK (United States)	
	19:18341	DOE/ER/13678–72
	19:19116	DOE/ER/13678–73
	19:19117	DOE/ER/13678–74
	19:19118	DOE/ER/13678–76
	19:19129	DOE/ER/13678–75
FG05-87ER40353	Tennessee Technological Univ., Cookeville, TN (United States). Dept. of Physics	
	19:20065	DOE/ER/40353–20
FG05-87ER60550	Texas A and M Univ., College Station, TX (United States). Dept. of Nuclear Engineering	
	19:18913	DOE/ER/60550–T3
FG05-88ER13821	Texas Univ., Austin, TX (United States)	
	19:20533	DOE/ER/13821–T1
FG05-88ER45368	Rutgers–the State Univ., Piscataway, NJ (United States). Dept. of Ceramics	
	19:19095	DOE/ER/45368–T1
FG05-88ER53267	Texas Univ., Austin, TX (United States). Fusion Research Center	
	19:20306	DOE/ER/53267–129
FG05-89ER14003	Oklahoma Univ., Norman, OK (United States). Dept. of Botany and Microbiology	
	19:18308	DOE/ER/14003–5
FG05-89ER60789	Duke Univ. Medical Center, Durham, NC (United States). Dept. of Radiology	
	19:19698	DOE/ER/60789–5

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FG05-89ER60894	Duke Univ. Medical Center, Durham, NC (United States). Dept. of Radiology	
	19:19699	DOE/ER/60894–5
FG05-92ER40717	Rice Univ., Houston, TX (United States). Bonner Nuclear Labs.	
	19:19949	DOE/ER/40717–10
	Lawrence Berkeley Lab., CA (United States)	
	19:19471	LBL-PUB–5380
FG05-93ER61604	Georgia State Univ., Atlanta, GA (United States). Dept. of Chemistry	
	19:19907	DOE/ER/61604–1
FG06-84ER45163	Washington Univ., Seattle, WA (United States). Dept. of Physics	
	19:19093	DOE/ER/45163–40
FG06-88ER60696	Oregon State Univ., Corvallis, OR (United States). Dept. of Agricultural Chemistry	
	19:19697	DOE/ER/60696–3
	19:19905	DOE/ER/60696–5
FG06-92EH89181	Washington State Univ., Richland, WA (United States)	
	19:19903	USTUR–0002-93
	Washington State Univ., Richland, WA (United States). Health Research and Education Center	
	19:19902	USTUR–0001-93
FG06-92ER14234	Alaska Univ., Fairbanks, AK (United States)	
	19:19914	DOE/ER/14234–2
FG06-92ER61417	Oregon Univ., Eugene, OR (United States). Dept. of Biology	
	19:19683	DOE/ER/61417–2
FG06-92ER61422	Oregon State Univ., Corvallis, OR (United States). Coll. of Oceanic and Atmospheric Sciences	
	19:19653	DOE/ER/61423–2
FG06-92ER61423	Oregon State Univ., Corvallis, OR (United States). Coll. of Oceanic and Atmospheric Sciences	
	19:19653	DOE/ER/61423–2
FG09-84ER13296	South Carolina Univ., Columbia, SC (United States). Dept. of Chemistry	
	19:19127	DOE/ER/13296–9
FG09-86ER13621	Georgia Univ., Athens, GA (United States). Research Foundation	
	19:19678	DOE/ER/13621–5
FG09-87ER13768	Clemson Univ., SC (United States). Hunter Chemistry Lab.	
	19:19130	DOE/ER/13768–4
FG09-87ER45291	Georgia Univ., Athens, GA (United States). Dept. of Physics and Astronomy	
	19:19094	DOE/ER/45291–7
	19:19295	DOE/ER/45291–8
FG09-88SR18048	Claflin Coll., Orangeburg, SC (United States)	
	19:20482	DOE/SR/18048–T1
FG09-88SR18049	South Carolina State Univ., Orangeburg, SC (United States). Dept. of Natural Sciences	
	19:19654	DOE/SR/18049–5
FG09-90ER14156	Georgia Univ., Athens, GA (United States). Dept. of Chemistry	
	19:19032	DOE/ER/14156–3
FG09-91ER20034	Georgia Univ., Athens, GA (United States). Dept. of Botany	
	19:19680	DOE/ER/20034–1
FG09-93SR18289	Georgia Emergency Management Agency, Atlanta, GA (United States)	
	19:19534	DOE/SR/18289–2
FG21-88MC25038	University of Wyoming Research Corp., Laramie, WY (United States). Western Research Inst.	
	19:17772	DOE/MC/25038–3457
FG22-87FE61146	Oklahoma Univ., Norman, OK (United States)	
	19:19116	DOE/ER/13678–73
	19:19118	DOE/ER/13678–76
	19:19129	DOE/ER/13678–75
FG22-87PC79916	Kentucky Univ., Lexington, KY (United States). Dept. of Mechanical Engineering	
	19:17828	DOE/PC/79916–T1
	19:19255	CONF-9204103–4
FG22-89PC89779	Minnesota Univ., Minneapolis, MN (United States). Dept. of Civil and Mineral Engineering	
	19:18450	DOE/PC/89779–T8
FG22-90PC90096	Tulsa Univ., OK (United States). Center for Environmental Research and Technology	
	19:17845	DOE/PC/90096–T6
FG22-90PC90285	Arizona Univ., Tucson, AZ (United States). Dept. of Chemical Engineering	
	19:18451	DOE/PC/90285–T12
FG22-90PC90286	California Inst. of Tech., Pasadena, CA (United States)	
	19:17892	DOE/PC/90286–T7
FG22-90PC90287	California Univ., Berkeley, CA (United States). Dept. of Materials Science and Mineral Engineering	
	19:17829	DOE/PC/90287–T13
FG22-90PC90291	Delaware Univ., Newark, DE (United States). Center for Catalytic Science and Technology	
	19:19135	DOE/PC/90291–T12
FG22-90PC90293	Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering	
	19:17784	DOE/PC/90293–T12
FG22-90PC90294	Purdue Univ., Lafayette, IN (United States)	
	19:17785	DOE/PC/90294–T4
FG22-90PC90298	Massachusetts Univ., Amherst, MA (United States). Dept. of Chemistry	
	19:17786	DOE/PC/90298–T16
FG22-90PC90302	Oklahoma State Univ., Stillwater, OK (United States). School of Chemical Engineering	
	19:17787	DOE/PC/90302–T9
	19:19136	DOE/PC/90302–T8
FG22-91PC91281	Auburn Univ., AL (United States). Dept. of Chemical Engineering	
	19:17801	DOE/PC/91281–T9
FG22-91PC91283	Tuskegee Univ., AL (United States). Dept. of Chemical Engineering	
	19:17746	DOE/PC/91283–T10
	19:17747	DOE/PC/91283–T11
	19:17748	DOE/PC/91283–T12
FG22-91PC91284	Stanford Univ., CA (United States). Dept. of Civil Engineering	
	19:19138	DOE/PC/91284–9
FG22-91PC91285	Yale Univ., New Haven, CT (United States). Dept. of Chemistry	
	19:17832	DOE/PC/91285–9
FG22-91PC91288	Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering	
	19:17802	DOE/PC/91288–T11

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FG22-91PC91290	Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research	
	19:17846	DOE/PC/91290–T9
FG22-91PC91291	Kentucky Univ., Lexington, KY (United States). Research Foundation	
	19:19139	DOE/PC/91291–T10
FG22-91PC91292	Grambling State Univ., LA (United States). Dept. of Chemistry	
	19:17833	DOE/PC/91292–T9
	19:17894	DOE/PC/91292–T10
FG22-91PC91293	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering	
	19:18457	DOE/PC/91293–8
FG22-91PC91299	State Univ. of New York, Binghamton, NY (United States). Dept. of Chemistry	
	19:17834	DOE/PC/91299–14
FG22-91PC91301	Lehigh Univ., Bethlehem, PA (United States)	
	19:17803	DOE/PC/91301–9
FG22-91PC91302	Pennsylvania State Univ., University Park, PA (United States)	
	19:17847	DOE/PC/91302–8
	19:17848	DOE/PC/91302–9
	19:17849	DOE/PC/91302–10
FG22-91PC91304	Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering	
	19:19140	DOE/PC/91304–T8
FG22-91PC91305	Brown Univ., Providence, RI (United States). Div. of Engineering	
	19:17835	DOE/PC/91305–9
FG22-91PC91309	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Center for Advanced Ceramic Materials	
	19:19069	DOE/PC/91309–T11
FG22-91PC91311	Auburn Univ., AL (United States). Dept. of Chemical Engineering	
	19:17804	DOE/PC/91311–T8
	19:17805	DOE/PC/91311–T10
FG22-92PC92525	California Inst. of Tech., Pasadena, CA (United States). Div. of Chemistry and Chemical Engineering	
	19:18301	DOE/PC/92525–T5
FG22-92PC92527	University of Southern California, Los Angeles, CA (United States). Dept. of Chemical Engineering	
	19:17813	DOE/PC/92527–T5
FG22-92PC92530	Ames Lab., IA (United States)	
	19:17895	DOE/PC/92530–T6
FG22-92PC92533	Kentucky Univ., Lexington, KY (United States). Dept. of Mechanical Engineering	
	19:19172	DOE/PC/92533–5
FG22-92PC92536	Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering	
	19:17853	DOE/PC/92536–T6
FG22-92PC92537	Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering	
	19:17814	DOE/PC/92537–T4
FG22-92PC92539	Tulsa Univ., OK (United States)	
	19:17896	DOE/PC/92539–6
FG22-92PC92543	Pennsylvania State Univ., University Park, PA (United States)	
	19:17752	DOE/PC/92543–T5
FG22-92PC92546	Utah Univ., Salt Lake City, UT (United States)	
	19:17753	DOE/PC/92546–T6
FG22-92PC92547	Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States)	
	19:17754	DOE/PC/92547–T3
FG22-93BC14862	Stanford Univ., CA (United States). Dept. of Petroleum Engineering	
	19:17915	DOE/BC/14862–2
FG22-93BC14875	Reservoir Engineering Research Inst., Palo Alto, CA (United States)	
	19:17916	DOE/BC/14875–1
FG22-93PC93202	Alabama Univ., University, AL (United States). Dept. of Chemistry	
	19:17841	DOE/PC/93202–2
FG22-93PC93205	Delaware Univ., Newark, DE (United States)	
	19:17815	DOE/PC/93205–T1
FG22-93PC93209	Iowa State Univ. of Science and Technology, Ames, IA (United States)	
	19:17816	DOE/PC/93209–T2
FG22-93PC93210	Kentucky Univ., Lexington, KY (United States). Dept. of Mechanical Engineering	
	19:17897	DOE/PC/93210–1
FG22-93PC93212	Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering	
	19:18355	DOE/PC/93212–T1
	19:19533	DOE/PC/93212–T2
FG22-93PC93213	Michigan State Univ., East Lansing, MI (United States)	
	19:17817	DOE/PC/93213–T2
FG22-93PC93214	Michigan Technological Univ., Houghton, MI (United States). Dept. of Metallurgical and Materials Engineering	
	19:18462	DOE/PC/93214–T2
FG22-93PC93215	Nevada Univ., Reno, NV (United States). Dept. of Chemical and Metallurgical Engineering	
	19:17818	DOE/PC/93215–T2
FG22-93PC93216	Cornell Univ., Ithaca, NY (United States). Sibley School of Mechanical and Aerospace Engineering	
	19:17819	DOE/PC/93216–T2
FG22-93PC93217	State Univ. of New York, Buffalo, NY (United States). Dept. of Chemical Engineering	
	19:17854	DOE/PC/93217–T2
FG22-93PC93219	Duke Univ., Durham, NC (United States). Dept. of Mechanical Engineering and Materials Science	
	19:18905	DOE/PC/93219–T1
FG22-93PC93220	Cincinnati Univ., OH (United States). Dept. of Chemical Engineering	
	19:17826	DOE/PC/93220–T2
FG22-93PC93221	Oklahoma Univ., Norman, OK (United States). School of Aerospace, Mechanical and Nuclear Engineering	
	19:17898	DOE/PC/93221–T1
FG22-93PC93222	Lehigh Univ., Bethlehem, PA (United States)	
	19:19142	DOE/PC/93222–1
	19:19143	DOE/PC/93222–2
FG22-93PC93224	South Carolina Univ., Columbia, SC (United States). Dept. of Biological Sciences	
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81722	19:19523	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005481	MF-400
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74856	19:19524	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009820	MF-402
77507	19:20477	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010468	MF-400
ANL/ESD–					
20	19:19007	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011486	
ANL/ESD/TM–					
62	19:18910	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010998	MF-900
63	19:19650	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011219	MF-121
ANL/ET/CP–					
80062	19:18536	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007632	MF-532
80384	19:18537	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009670	MF-400
81294	19:18002	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010433	MF-902
81295	19:18961	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011479	MF-114
81839	19:19057	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010462	MF-373
82281	19:19023	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011521	MF-109
82282	19:19024	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011505	MF-104; MF-109
82379	19:19252	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009806	MF-403; MF-406
ANL/EWM/VU–					
82273	19:18755	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008463	MF-902
ANL/FE–					
94-01	19:19494	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011326	PC-103
ANL/FPP/TM–					
265	19:20221	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010995	PC-423
ANL/IPD/CP–					
82431	19:20585	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009736	MF-905
ANL/ITD/RP–					
82647	19:19058	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010436	MF-364
ANL/MCS-TM–					
185	19:20505	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010104	MF-405
187	19:20506	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012108	MF-405
ANL/MCS/CP–					
82803	19:20502	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011512	MF-405
82804	19:20503	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011513	MF-405
82809	19:19913	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011514	MF-405
ANL/MCS/PP–					
72469	19:20504	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011485	MF-405
74001	19:19253	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011488	MF-405

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ANL/MCT/PP–					
78088	19:18955	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010451	
ANL/MSD/CP–					
77644	19:19025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011520	MF-404
81222	19:19059	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010432	MF-404
82160	19:19026	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011504	MF-404
82168	19:19126	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009680	MF-404
82380	19:19027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009823	MF-404
82465	19:19028	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010452	MF-404
82631	19:18289	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010442	MF-404
82716	19:19029	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011496	MF-404
ANL/MSD/PP–					
72937	19:20293	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010447	MF-404
73020	19:19060	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010448	MF-404
73106	19:20294	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011472	MF-404
73644	19:19061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010441	MF-404
73888	19:19062	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010449	MF-404
74577	19:19030	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010450	MF-404
75768	19:19063	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010430	MF-401; MF-404
76773	19:19064	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010443	MF-222; MF-404
77650	19:19286	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011519	MF-404
ANL/OTD-APS/CP–					
81621	19:19342	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009690	MF-404; MF-411
81622	19:19317	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009691	MF-404; MF-411
ANL/OTD-ER/CP–					
82305	19:18263	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009734	MF-533
ANL/OTM/CR–					
5	19:19013	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010353	MF-373
ANL/PHY/CP–					
82591	19:20123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010454	MF-413
82605	19:19328	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010445	MF-411
82606	19:20066	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010446	MF-413
ANL/RA/CP–					
79957	19:18756	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007675	MF-520
79958	19:18757	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007627	MF-520
79959	19:18758	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007624	MF-532
80012	19:18759	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007653	MF-538; MF-542
80013	19:18760	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007676	MF-507
80014	19:18761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007677	MF-530
80023	19:18762	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007625	MF-532
80137	19:18763	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007654	MF-542
80139	19:18764	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007639	MF-538
80293	19:18765	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007638	MF-506; MF-530
80314	19:18538	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007679	MF-532
80315	19:18539	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007683	MF-532
80768	19:18623	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007628	MF-523
82382	19:20507	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009801	MF-506
ANL/TD/CP–					
81180	19:20238	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011524	
82235	19:18639	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008460	MF-900
ARM–					
94-001	19:19525	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012114	MF-402
ASIPP–					
0004.	19:20295	*See* CNIC–00224			
0034.	19:20430	*See* CNIC–00641			
AUC-IBT-R–					
9331	19:19292	OSTI; NTIS		DE94763237	
9334	19:18416	OSTI; NTIS		DE94763238	
BHARC–					
700/93/042	19:18577	*See* NUREG/CR–6123			
BICM–					
0008.	19:19114	*See* CNIC–00717			
BINE–					
0022.	19:19182	*See* CNIC–00727			

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BLG–					
634	19:19577	OSTI; NTIS (US Sales Only); INIS		DE94624245	
635	19:18626	OSTI; NTIS (US Sales Only); INIS		DE94624377	
636	19:19836	OSTI; NTIS (US Sales Only); INIS		DE94624403	
638	19:19578	OSTI; NTIS (US Sales Only); INIS		DE94624246	
639	19:19082	OSTI; NTIS (US Sales Only); INIS		DE94624233	
641	19:18004	OSTI; NTIS (US Sales Only); INIS		DE94624776	
BMI–					
2173-Vol.3-No.2	19:18589	*See* NUREG/CR–4599-Vol.3-No.2			
BNL–					
34518-Rev.4/94	19:20064	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011737	MF-414
49263	19:18466	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011730	MF-400
49761	19:18005	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011738	MF-902; MF-940
49773	19:19932	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004949	MF-408
49799	19:19329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011919	MF-414
49800	19:19330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011920	MF-414
49841	19:18988	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005507	MF-900
49863	19:18767	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009000	MF-400
49975	19:18264	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007165	MF-515
49979	19:18265	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007164	MF-515
52407	19:19315	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010310	MF-400
60041	19:19083	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006570	MF-401
60059	19:18006	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007163	MF-402
60072	19:19432	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009107	MF-414
60131	19:18266	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008998	MF-515
60245	19:20124	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011726	MF-414
60259	19:19651	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011917	
60282	19:20057	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011734	MF-414
60302	19:19343	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011183	MF-414
60303	19:19433	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011184	MF-414
60304	19:19434	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011185	MF-414
60326	19:18396	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011731	MF-404
60337	19:19695	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011198	MF-601
60341	19:19163	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011762	MF-601
60355	19:20058	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011733	MF-413
60385	19:19435	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011193	MF-406
BNL-NUREG–					
49578	19:18768	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009108	
49797	19:18769	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005456	
49996	19:18584	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007172	
52412	19:18489	*See* NUREG/CR–6200			
60007	19:18770	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007522	
60148	19:18771	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008999	
60203	19:18563	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009073	
BONN-AM–					
94-01	19:20230	OSTI; NTIS (US Sales Only); INIS		DE94769238	
BONN-HE–					
93-43	19:19950	OSTI; NTIS (US Sales Only); INIS		DE94769123	
93-49	19:19951	OSTI; NTIS (US Sales Only); INIS		DE94769121	
93-52	19:19952	OSTI; NTIS (US Sales Only); INIS		DE94769154	
BONN-IR–					
92-34	19:20067	OSTI; NTIS (US Sales Only); INIS		DE94769096	
92-55	19:19436	OSTI; NTIS (US Sales Only); INIS		DE94766581	
93-65	19:19989	OSTI; NTIS (US Sales Only); INIS		DE94769138	
93-71	19:20015	OSTI; NTIS (US Sales Only); INIS		DE94769140	
93-72	19:20016	OSTI; NTIS (US Sales Only); INIS		DE94769095	
BRIUOP–					
0009.	19:17947	*See* CNIC–00225			
BROWN-HET–					
872	19:20056	*See* ANL-HEP-PR–93-4			
BfS-ISH–					
161/93	19:19822	OSTI; NTIS (US Sales Only); INIS		DE94769179	
BfS-KT–					
6/93	19:18870	OSTI; NTIS (US Sales Only); INIS		DE94769566	
CBP–					
052	19:19316	*See* LBL–35143			
71	19:19399	*See* LBL–35323			
CDM/LSO/DSO–					
58	19:19112	OSTI; NTIS (US Sales Only); INIS		DE94624075	

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CEA-CONF–					
11629	19:19344	OSTI; NTIS (US Sales Only); INIS		DE94622496	
CEA-DAPNIA-SPP–					
93-06	19:20059	OSTI; NTIS (US Sales Only); INIS		DE94622830	
CEBAF-PR–					
94-001	19:20061	*See* DOE/ER/40150–262			
94-003	19:19331	*See* DOE/ER/40150–264			
CERN–					
93-01	19:19345	OSTI; NTIS (US Sales Only); INIS		DE94623621	
CERN-TH–					
6912/93	19:19984	*See* NIKHEF-H–93-13			
CNIC–					
00119	19:20508	OSTI; NTIS (US Sales Only); INIS		DE94624805	
00120	19:20509	OSTI; NTIS (US Sales Only); INIS		DE94624806	
00127	19:19254	OSTI; NTIS (US Sales Only); INIS		DE94624626	
00224	19:20295	OSTI; NTIS (US Sales Only); INIS		DE94625101	
00225	19:17947	OSTI; NTIS (US Sales Only); INIS		DE94624145	
00641	19:20430	OSTI; NTIS (US Sales Only); INIS		DE94625074	
00655	19:20302	OSTI; NTIS (US Sales Only); INIS		DE94625041	
00659	19:20303	OSTI; NTIS (US Sales Only); INIS		DE94625042	
00679	19:20304	OSTI; NTIS (US Sales Only); INIS		DE94625037	
00682	19:19437	OSTI; NTIS (US Sales Only); INIS		DE94624705	
00689	19:20510	OSTI; NTIS (US Sales Only); INIS		DE94624803	
00691	19:20305	OSTI; NTIS (US Sales Only); INIS		DE94625048	
00693	19:19837	OSTI; NTIS (US Sales Only); INIS		DE94624343	
00696	19:19579	OSTI; NTIS (US Sales Only); INIS		DE94624247	
00700	19:20511	OSTI; NTIS (US Sales Only); INIS		DE94624804	
00708	19:19799	OSTI; NTIS (US Sales Only); INIS		DE94624366	
00709	19:19438	OSTI; NTIS (US Sales Only); INIS		DE94624719	
00710	19:20586	OSTI; NTIS (US Sales Only); INIS		DE94624799	
00712	19:19838	OSTI; NTIS (US Sales Only); INIS		DE94624350	
00713	19:19113	OSTI; NTIS (US Sales Only); INIS		DE94624076	
00715	19:19652	OSTI; NTIS (US Sales Only); INIS		DE94624272	
00716	19:19839	OSTI; NTIS (US Sales Only); INIS		DE94624356	
00717	19:19114	OSTI; NTIS (US Sales Only); INIS		DE94624089	
00727	19:19182	OSTI; NTIS (US Sales Only); INIS		DE94624638	
00731	19:18007	OSTI; NTIS (US Sales Only); INIS		DE94624773	
CONF-880662–		(28. annual conference of the Canadian Nuclear Association and the 9. annual conference of the Canadian Nuclear Society; Winnipeg (Canada); 12-15 Jun 1988)			
	19:20490	*See* INIS-mf–13849			
CONF-900621–		(30. annual conference of the Canadian Nuclear Association and the 11th annual conference of the Canadian Nuclear Society; Toronto (Canada); 3-7 Jun 1990)			
	19:18526	*See* INIS-mf–13846			
	19:18527	*See* INIS-mf–13847			
CONF-9009546–		(History of NATO TNF policy: the role of studies, analysis and exercises conference; Livermore, CA (United States); 12-14 Sep 1990)			
Vol.1	19:19510	*See* SAND–91-8010/1			
CONF-9009548–		(2. international school on reliability and safety of NPP; Varna (Bulgaria); 10-15 Sep 1990)			
	19:18478	*See* INIS-mf–13817			
	19:18479	*See* INIS-mf–13855			
	19:18586	*See* INIS-mf–13805			
CONF-9009550–		(5. All-Union scientific conference on ionizing radiation protection of nuclear-technical installations; Protvino (Russian Federation); 19-21 Sep 1990)			
	19:19322	*See* INIS-RU–375			
CONF-910116–		(8. symposium on space nuclear power systems; Albuquerque, NM (United States); 6-10 Jan 1991)			
27	19:18554	*See* WHC-SA–0907-S			
28	19:18556	*See* WHC-SA–0913-S			
29	19:18555	*See* WHC-SA–0912-S			
30	19:18625	*See* WHC-SA–0896-S			
31	19:18557	*See* WHC-SA–0917-S			

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CONF-9103282–		(Working seminar on fusion reactions in condensed matter and all-union conference on cold fusion; Working seminar on "Fusion reactions in condensed matter" and All-union conference on "Cold fusion"; Dubna (Russian Federation); Moscow (Russian Federation); 22-26 Mar 1991; 25-26 mar 1991)			
	19:20413	*See* INIS-RU–364			
CONF-9103283–		(Working seminar on fusion reactions in condensed matter and all-union conference on cold fusion; Working seminar on "Fusion reactions in condensed matter" and All-union conference on "Cold fusion"; Dubna (Russian Federation); Moscow (Russian Federation); 22-26 Mar 1991; 25-26 mar 1991)			
	19:20413	*See* INIS-RU–364			
CONF-9103287–		(Seminar for journalists: The consequences of Chernobyl for Germany and the former Soviet Union; Neuherberg (Germany); 18-19 Mar 1991)			
	19:19843	*See* GSF–17/92			
CONF-9106370–		(4. European fusion theory conference; Aspenaes (Sweden); 10-19 Jun 1991)			
	19:20312	*See* INIS-mf–13809(v.1,2)			
CONF-9109458–		(EORTC breast cancer working conference; Leuven (Belgium); 3-6 Sep 1991)			
	19:19701	*See* IAEA-TECDOC–734			
CONF-9109540–		(46. Annual Congress of Brazilian Association of Metals; Sao Paulo (Brazil); 15-18 Sep 1991)			
	19:19036	*See* INIS-BR–3307			
	19:19070	*See* INIS-BR–3308			
CONF-9203300–		(International symposium on global change (IGBP); Tokyo (Japan); 27-29 Mar 1992)			
	19:19539	*See* INIS-JP–019			
CONF-9204103–		(Combustion Institute central states spring meeting on combustion fundamentals and applications; Columbus, OH (United States); 26-28 Apr 1992)			
4	19:19255	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011690	MF-113
CONF-9204285–		(Science careers in search of women conference; Argonne, IL (United States); 24 Apr 1992)			
	19:20476	*See* ANL/DEP/PROC–82423			
CONF-920431–		(Meeting on new horizons in radiation protection and shielding; Pasco, WA (United States); 26 Apr - 1 may 1992)			
31	19:18558	*See* WHC-SA–1347-S			
32	19:18809	*See* WHC-SA–1332-S			
33	19:18559	*See* WHC-SA–1348-S			
CONF-920444–		(203. American Chemical Society (ACS) national meeting; San Francisco, CA (United States); 5-10 Apr 1992)			
41	19:19902	*See* USTUR–0001-93			
CONF-9205269–		(Realistic nuclear structure meeting; Stony Brook, NY (United States); 28-30 May 1992)			
2	19:20097	*See* LA-UR–94-1271			
CONF-9206442–		(1. international workshop in human chromosome 6; Ann Arbor, MI (United States); 7-9 Jun 1992)			
Summ.	19:19690	*See* DOE/ER/61427–1			
CONF-9206444–		(Study meeting on nuclear physics of quasi-elastic scattering; Ibaraki (Japan); 8-10 Jun 1992)			
	19:20053	*See* RCNP-P–123			
CONF-9206445–		(NATO Advanced Study Institute workshop; Maratea (Italy); 28 Jun - 10 jul 1992)			
1	19:19428	*See* LBL–34751			
2	19:19397	*See* LBL–34750			

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CONF-9206446–		(Study meeting on dynamics of quarks-hadrons in atomic nuclei; Ibaraki (Japan); 11-13 Jun 1992)			
	19:20011	*See* RCNP-P–122			
CONF-920815–		(204. American Chemical Society (ACS) national meeting; Washington, DC (United States); 23-28 Aug 1992)			
30	19:18006	*See* BNL–60059			
CONF-9208257–		(47. Annual Congress of Brazilian Association of Metallurgy and Materials; Belo Horizonte (Brazil); 10-13 Aug 1992)			
	19:19035	*See* INIS-BR–3306			
CONF-920828–		(American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings; Pacific Grove, CA (United States); 30 Aug - 5 sep 1992)			
30	19:18920	*See* LBL–35402			
CONF-9209300–		(Advances in reliability analysis and probabilistic safety assessment; Budapest (Hungary); 7-11 Sep 1992)			
	19:18795	*See* IAEA-TECDOC–737			
CONF-9209459–		(1992 Joint seminar of the LVIS-2000 and ETRR research programmes; Espoo (Finland); 23 Sep 1992)			
	19:18933	*See* VTT/LVIS2000–15			
CONF-9209462–		(26. international symposium Ahrenshoop on the theory of elementary particles; Wendisch Rietz (Germany); 9-13 Sep 1992)			
	19:19947	*See* DESY–93-013			
CONF-920970–		(3. conference on evolution of microstructure in metals during irradiation; Chalk River (Canada); 29 Sep - 2 oct 1992)			
10	19:19025	*See* ANL/MSD/CP–77644			
CONF-9210428–		(New possibilities for a secure and just world; Berkeley, CA (United States); 2 Oct 1992)			
	19:18872	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010072	MF-700
CONF-9210457–		(Superconducting super collider conference; Dallas, TX (United States); 29 Oct 1992)			
1	19:19429	*See* SLAC-PUB–6458			
CONF-9210459–		(Seminar: Thorium, and the problems posed for incorporation monitoring - applications, measurements, evaluation and interpretation; Scheyern (Germany); 12-13 Oct 1992)			
	19:19822	*See* BfS-ISH–161/93			
CONF-9210460–		(3. workshop on information management in nuclear safety, radiation protection and environmental protection (WINRE-3); Koeln (Germany); 14-15 Oct 1992)			
	19:20589	*See* GRS–96			
CONF-9211198–		(5. ECMWF workshop on parallel processing in meteorology; Reading (United Kingdom); 23 Nov 1992 - 27 nov 1993)			
2	19:19913	*See* ANL/MCS/CP–82809			
CONF-930005–		(Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Munich (Germany); Annecy (France); Hamburg (Germany); 1993; 1993; 1993)			
	19:20020	*See* DESY–93-099			
CONF-930006–		(Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Munich (Germany); Annecy (France); Hamburg (Germany); 1993; 1993; 1993)			
	19:20020	*See* DESY–93-099			
CONF-930007–		(Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Workshop on 500 GeV e+e- linear collider; Munich (Germany); Annecy (France); Hamburg (Germany); 1993; 1993; 1993)			
	19:20020	*See* DESY–93-099			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9301142–		(KT/KTA winter seminar: Nuclear engineering in the Federal Republic of Germany in 1993 - tasks, problems and prospects from the point of view of those concerned; Salzgitter (Germany); 28-29 Jan 1993)			
	19:18870	*See* BfS-KT–6/93			
CONF-930157–		(Specialist meeting on fuel-coolant interactions; Santa Barbara, CA (United States); 5-7 Jan 1993)			
	19:18798	*See* NUREG/CP–0127			
CONF-930173–		(HIPAGS 93: workshop on heavy ion physics at the alternating gradient synchrotron; Cambridge, MA (United States); 14-17 Jan 1993)			
14	19:20124	*See* BNL–60245			
CONF-930187–		(13. Moriond workshop on perspectives in neutrinos, atomic physics, and gravitation; Villars-sur-Ollon (Switzerland); 30 Jan - 6 feb 1993)			
	19:20059	*See* CEA-DAPNIA-SPP–93-06			
CONF-9302177–		(Meeting on beam monitors for Cyclotrons and related Facilities; Tokyo (Japan); 24 Feb 1993)			
	19:19354	*See* INS-T–521			
CONF-9302178–		(International workshop on high-resolution sprectroscopy of fission fragments, neutrons, and gamma-rays; Dresden (Germany); 1-2 Feb 1993)			
	19:19448	*See* FZR–93-08			
CONF-9303122–		(3. Atmospheric Radiation Measurement (ARM) science team meeting; Norman, OK (United States); 1-5 Mar 1993)			
	19:19526	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011194	MF-402
5-Rev.1	19:19568	*See* UCRL-JC–113583-Rev.1			
CONF-9303278–		(Conference on reliability and optimization of structural systems; Takamatsu-shi (Japan); 24-26 Mar 1993)			
1	19:19292	*See* AUC-IBT-R–9331			
CONF-9303279–		(Symposium in honor of Tetsuro Kobayashi's 63rd birthday; Tokyo (Japan); 19 Mar 1993)			
	19:20019	*See* DESY–93-096			
CONF-9304245–		(Seminar on mathematical models in nuclear safety and radiation protection; Sofia (Bulgaria); 7-8 Apr 1993)			
	19:18513	*See* INIS-mf–13804			
CONF-9304246–		(Republican scientific and practical conference; Khar'kov (Ukraine); 28-29 Apr 1993)			
	19:19752	*See* INIS-UA–003			
CONF-9304247–		(2. research co-ordination meeting on activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology; Del Mar, CA (United States); 29-30 Apr 1993)			
	19:20143	*See* INDC(NDS)–286/L			
	19:20158	*See* INDC(NDS)–288/L			
CONF-930482–		(2. international symposium in situ and on-site bioreclamation; San Diego, CA (United States); 5-8 Apr 1993)			
12	19:19623	*See* PNL-SA–21763			
CONF-930511–		(PAC '93: international particle accelerator conference; Washington, DC (United States); 17-20 May 1993)			
	19:19333	*See* GANIL-A–93-04			
	19:19344	*See* CEA-CONF–11629			
	19:19351	*See* GANIL-A–93-05			
518	19:19342	*See* ANL/OTD-APS/CP–81621			
CONF-9305177–		(12. International collaboration of advanced neutron sources meeting (ICANS); Abingdon (United Kingdom); 24-28 May 1993)			
17	19:19317	*See* ANL/OTD-APS/CP–81622			

CONF-9305203–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9305203–		(International school seminar on heavy ion physics; Dubna (Russian Federation); 10-15 May 1993)			
	19:20159	*See* JINR-E–7-93-126			
CONF-9305229–		(11. international workshop on electron resonance ion sources; Groningen (Netherlands); 5-8 May 1993)			
	19:19349	*See* GANIL-A–93-02			
	19:19350	*See* GANIL-A–93-03			
CONF-9305257–		(Lawrence Livermore National Laboratory (LLNL) technical woman's symposium; Lafayette, CA (United States); 6-7 May 1993)			
	19:18857	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006616	MF-700
CONF-9305314–		(2. two-arm photon spectrometer (TAPS) workshop; Guardamar (Spain); 31 May - 5 jun 1993)			
	19:20116	*See* GANIL-P–93-22			
CONF-9305317–		(1993 international conference on strings; Berkeley, CA (United States); 24-29 May 1993)			
2	19:19982	*See* LBL–34610			
CONF-9305320–		(1. workshop on emissions and modelling of atmospheric transport of persistent organic pollutants and heavy metals; Durham, NC (United States); 6-7 May 1993)			
1-Vugraphs	19:19523	*See* ANL/ER/CP–81722			
CONF-9305345–		(Clouds and radiation in GCM's; Stockholm (Sweden); 24-26 May 1993)			
	19:19548	*See* MISU-IMI-DM–64			
CONF-9305349–		(Workshop and conference on grand challenges applications and software technology; Pittsburgh, PA (United States); 4-7 May 1993)			
	19:20560	*See* GCW–0593			
CONF-9305352–		(26. meeting of the International Working Group on Fast Reactors; Vienna (Austria); 4-7 May 1993)			
	19:18541	*See* IAEA-TECDOC–741			
CONF-930604–		(Conference on perspectives in nuclear structure; Copenhagen (Denmark); 14-18 Jun 1993)			
	19:20068	*See* GANIL-P–93-18			
1	19:20099	*See* LBL–34928			
CONF-9306105–		(5. international symposium on heavy flavour physics; Montreal (Canada); 6-10 Jun 1993)			
	19:20024	*See* DESY–93-168			
CONF-9306140–		(Coherent states: past present and future; Oak Ridge, TN (United States); 14-17 Jun 1993)			
3	19:19925	*See* DOE/ER/40757–015			
CONF-9306166–		(Oak Ridge National Laboratory (ORNL) refrigeration and air conditioning technology workshop; Breckenridge, CO (United States); 23-25 Jun 1993)			
	19:18923	*See* ORNL–6797			
CONF-9306218–		(International symposium on local order in condensed matter physics; Jekyll Island, GA (United States); 14-17 Jun 1993)			
1	19:19065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009177	MF-401
CONF-9306221–		(19 international conference on elastic and diffractive scattering (5th Blois workshop); Providence, RI (United States); 8-12 Jun 1993)			
10	19:20044	*See* FNAL/C–93/337-E			
CONF-9306305–		(1994 American Nuclear Society (ANS) annual meeting; New Orleans, LA (United States); 19-23 Jun 1993)			
1-Rev.1	19:18261	*See* WSRC-MS–93-474-Rev.1			
CONF-930637–		(13. international conference on particles and nuclei; Perugia (Italy); 27 Jun - 3 jul 1993)			
15	19:20058	*See* BNL–60355			
CONF-930713–		(10. detonation symposium; Boston, MA (United States); 12-16 Jul 1993)			
33	19:19504	*See* SAND–92-2016C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9307160–		(New York Academy of Sciences conference on DNA damage: effects on DNA structure and protein recognition; Burlington, VT (United States); 31 Jul - 4 aug 1993)			
1	19:19688	*See* PNL-SA–22964			
CONF-9307177–		(AINSE plasma science and technology conference and Elizabeth and Frederick White workshop on fundamental problems in the physics of magnetically confined plasma; Canberra (Australia); 12-15 Jul 1993)			
	19:20301	*See* INIS-mf–13853			
CONF-9307180–		(48. Annual Congress of Brazilian Association of Metallurgy and Materials; Rio de Janeiro (Brazil); 25-28 Jul 1993)			
	19:19037	*See* INIS-BR–3310			
	19:19071	*See* INIS-BR–3309			
	19:19072	*See* INIS-BR–3311			
CONF-930761–		(International Europhysics conference on high-energy physics; Marseille (France); 22-28 Jul 1993)			
	19:19993	*See* DESY–93-150			
	19:20028	*See* DESY–93-186			
	19:20029	*See* DESY–93-187			
	19:20033	*See* DESY–93-197			
	19:20035	*See* DESY–94-005			
	19:20040	*See* DESY–94-015			
CONF-930767–		(21. annual SLAC Summer Institute on particle physics: spin structure in high-energy processes; Stanford, CA (United States); 26 Jul - 6 aug 1993)			
6	19:19339	*See* SLAC-PUB–6448			
7	19:20055	*See* SLAC-PUB–6470			
8	19:20012	*See* SLAC-PUB–6450			
CONF-930809–		(8. ASTM-EURATOM symposium on reactor dosimetry; Vail, CO (United States); 29 Aug - 3 sep 1993)			
13	19:18580	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94002438	
CONF-9308107–		(Joint American Statistical Association (ASA), Institute of Mathematics Statistics and Biometric Society conference; San Francisco, CA (United States); 8-12 Aug 1993)			
5	19:18111	*See* PNL-SA–22809			
CONF-9308160–		(24. annual meeting of the Fine Particle Society; Chicago, IL (United States); 24-28 Aug 1993)			
2	19:19076	*See* PNL-SA–22235			
CONF-9308168–		(International seminar on planetary emergencies; Erice (Italy); 19-24 Aug 1993)			
5	19:19517	*See* UCRL-JC–114854			
CONF-9308179–		(42. annual Denver x-ray conference; Denver, CO (United States); 2-6 Aug 1993)			
2	19:18466	*See* BNL–49263			
CONF-9308181–		(Pre-equilibrium Parton dynamics; Berkeley, CA (United States); 23 Aug - 3 sep 1993)			
	19:20006	*See* LBL–34831			
CONF-9308199–		(23. Mazurian Lakes summer school on nuclear physics: Frontier topics in nuclear, astronuclear and astroparticle physics; Piaski (Poland); 18-28 Aug 1993)			
	19:20134	*See* GSI–93-75(prepr.)			
CONF-9308207–		(3. technology transfer/communications conference; Berkeley, CA (United States); 9 Aug - 11 sep 1993)			
Amend.	19:20478	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010410	MF-900
CONF-9308210–		(3. workshop on relativistic aspects of nuclear physics; Rio de Janeiro (Brazil); 25-27 Aug 1993)			
2	19:20007	*See* LBL–35128			
CONF-9308225–		(Regular advisory group meeting on spent fuel management: Current status and prospects; Vienna (Austria); 31 Aug - 3 sep 1993)			
	19:18063	*See* IAEA-TECDOC–732			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9308226–		(Rhenium-Catecholato complexes and their reactivity with organohydrazines; Chicago, IL (United States); 22-27 Aug 1993)			
1	19:19696	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010423	MF-408
CONF-9308227–		(5. computer security incident handling workshop; St. Louis, MO (United States); 10-13 Aug 1993)			
1	19:20579	*See* UCRL-JC–113899			
CONF-930824–		(Synchrotron radiation instrumentation; Gaithersburg, MD (United States); 23-26 Aug 1993)			
31	19:19932	*See* BNL–49773			
36	19:19401	*See* SLAC-PUB–6342			
CONF-930873–		(2. international mixed waste symposium; Baltimore, MD (United States); 17-20 Aug 1993)			
31	19:18112	*See* PNL-SA–22895			
CONF-930893–		(Joint contractors meeting on advanced turbine systems, fuel cells and coal-fired heat; Morgantown, WV (United States); 3-5 Aug 1993)			
3	19:18904	*See* DOE/MC/29237–94/C0248			
15	19:17886	*See* DOE/MC/23165–94/C0257			
19	19:19002	*See* DOE/MC/27221–94/C0243			
31	19:19293	*See* DOE/MC/29061–94/C0269			
33	19:18901	*See* DOE/FE/61684–94/C0264			
36	19:18446	*See* DOE/METC/C–94/7105			
CONF-930913–		(Global '93: future nuclear systems - emerging fuel cycles and waste disposal options; Seattle, WA (United States); 12-17 Sep 1993)			
48	19:18084	*See* LA-UR–94-1087			
CONF-9309161–		(Digital systems reliability and nuclear safety workshop; Rockville, MD (United States); 13-14 Sep 1993)			
	19:18799	*See* NUREG/CP–0136			
CONF-9309170–		(5. international workshop on targetry and target chemistry; Upton, NY (United States); 20-24 Sep 1993)			
1	19:19695	*See* BNL–60337			
2	19:19163	*See* BNL–60341			
CONF-9309228–		(Focus 93: site characterization and model validation; Las Vegas, NV (United States); 26-29 Sep 1993)			
5	19:18082	*See* LA-UR–93-3691			
CONF-9309256–		(3. London conference on position-sensitive detectors; London (United Kingdom); 6-10 Sep 1993)			
5	19:19439	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011336	MF-414
CONF-9309257–		(Coal liquefaction and gas conversion contractor's review conference; Pittsburgh, PA (United States); 27-29 Sep 1993)			
3	19:17765	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012309	MF-108
CONF-930926–		(13. international conference on magnet technology; Victoria (Canada); 20-24 Sep 1993)			
31	19:20057	*See* BNL–60282			
CONF-930928–		(6. international conference on fusion reactor materials; Stresa (Italy); 27 Sep - 1 oct 1993)			
22	19:20461	*See* PNL-SA–22898			
29	19:19048	*See* PNL-SA–22457			
CONF-9309288–		(Workshop on photocathodes for polarized electron sources for accelerators; Stanford, CA (United States); 8-10 Sep 1993)			
Rev.	19:19400	*See* SLAC–432-Rev.			
CONF-9309295–		(Nuclear as a large-scale global option conference; Oak Ridge, TN (United States); 28-30 Sep 1993)			
2	19:18540	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004741	MF-400
CONF-9309297–		(23. international symposium on multiparticle dynamics; Aspen, CO (United States); 13-17 Sep 1993)			
10	19:20062	*See* FNAL/C–94/044-E			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9309310–		(5. joint Department of Energy/National Science Foundation (DOE/NSF) workshop on flow of particulates; Ithaca, NY (United States); 29 Sep - 1 oct 1993)			
	19:19257	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009727	MF-117
CONF-9309365–		(Testing readiness briefing to Department of Energy (DOE) officials; Las Vegas, NV (United States); 14 Sep 1993)			
1	19:19512	*See* UCRL-JC–114882			
CONF-9309368–		(Workshop on future buildings innovative low-energy concepts; Espoo (Finland); 1-3 Sep 1993)			
	19:18936	*See* VTT-SYMP–139			
CONF-930937–		(Course and workshop on tritium technology for fusion reactors; Varenna (Italy); 6-14 Sep 1993)			
3	19:20475	*See* WSRC-MS–93-282			
CONF-9309370–		(IGORR-III: 3. meeting of the international group on research reactors; Naka (Japan); 30 Sep - 1 oct 1993)			
	19:18745	*See* INIS-JP–020			
CONF-9309376–		(International conference on hadron structure; Bratislava (Slovakia); Sep 1993)			
	19:20022	*See* DESY–93-160			
CONF-930999–		(NATO Advanced Study Institute on hot and dense nuclear matter; Bodrum (Turkey); 26 Sep - 9 oct 1993)			
	19:20137	*See* GSI–94-02(prepr.)			
10	19:20220	*See* LBL–35330			
CONF-9310191–		(1993 international CCFC and halon alternatives conference; Washington, DC (United States); 20-22 Oct 1993)			
2	19:19528	*See* DOE/CE/23810–25			
CONF-9310193–		(CERN workshop on beam cooling and related topics; Geneva (Switzerland); 4-8 Oct 1993)			
11	19:19328	*See* ANL/PHY/CP–82605			
12	19:19338	*See* LBL–35232			
CONF-9310212–		(IPCC conference; Philadelphia, PA (United States); 5-8 Oct 1993)			
1	19:20604	*See* LA-UR–93-3546			
CONF-9310222–		(Seminar on physics of vapor explosion; Tomakomai (Japan); 25-29 Oct 1993)			
1	19:19919	*See* LA-UR–93-3699			
CONF-931023–		(ICALEPCS'93: International conference on accelerators and large experimental physics control systems; Berlin (Germany); 18-22 Oct 1993)			
	19:19319	*See* GANIL-A–93-06			
CONF-9310239–		(3. annual conference on astronomical data analysis software and systems; Victoria (Canada); 13-15 Oct 1993)			
2	19:19934	*See* FNAL/C–94/084			
CONF-9310241–		(9. American Institute of Aeronautics and Astronautics (AIAA) computing in aerospace conference; San Diego, CA (United States); 19-21 Oct 1993)			
1	19:19557	*See* PNL-SA–23164			
CONF-9310247–		(9. workshop on proton-antiproton collider physics; Tsukuba (Japan); 18-22 Oct 1993)			
	19:20042	*See* DESY–94-023			
CONF-9310250–		(LATTICE 93: international symposium on lattice field theory; Dallas, TX (United States); 12-17 Oct 1993)			
	19:19996	*See* DESY–93-180			
CONF-9310253–		(Indo-U.S. workshop; New Delhi (India); 7-16 Oct 1993)			
1	19:19897	*See* PNL-SA–23160			
CONF-9310261–		(SCIFI 93: workshop on scintillating fiber detectors; South Bend, IN (United States); 24-28 Oct 1993)			
	19:19442	*See* DESY–93-201			

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5-Pt.2	19:19475	*See* PNL-SA–23096			
6-Pt.3	19:19474	*See* PNL-SA–23094			
CONF-9310276–		(8. wildland shrub and arid land restoration symposium; Las Vegas, NV (United States); 19-21 Oct 1993)			
1	19:19591	*See* EGG–11265-2030			
2	19:18044	*See* EGG–11265-2031			
CONF-9310284–		(6. advanced ICFA beam dynamics workshop; Madeira (Portugal); 24-30 Oct 1993)			
4	19:19316	*See* LBL–35143			
CONF-9310314–		(400 MeV beam workshop; Batavia, IL (United States); 24-27 Oct 1993)			
1	19:19398	*See* LBL–34966			
CONF-9310315–		(9. high-energy heavy-ion study; Berkeley, CA (United States); 25-29 Oct 1993)			
1	19:20218	*See* LBL–35229			
CONF-9310316–		(Cosmic winds and the heliosphere conference; Tucson, AZ (United States); 18-22 Oct 1993)			
1	19:19946	*See* UCRL-JC–116941			
CONF-9310317–		(3. international workshop on software engineering, artifical intelligence (AI) and expert systems for high energy and nuclear physics; Oberammergau (Germany); 4-8 Oct 1993)			
	19:19440	*See* DESY–93-167			
CONF-931048–		(11. international workshop on laser interaction and related plasma phenomena; Monterey, CA (United States); 25-29 Oct 1993)			
12	19:20473	*See* UCRL-JC–114963			
13	19:20472	*See* UCRL-JC–107799			
14	19:20465	*See* SAND–93-2198C			
CONF-931079–		(21. water reactor safety information meeting; Bethesda, MD (United States); 25-27 Oct 1993)			
20	19:18770	*See* BNL-NUREG–60007			
21	19:18806	*See* SAND–94-0377C			
23	19:18771	*See* BNL-NUREG–60148			
24	19:18768	*See* BNL-NUREG–49578			
26	19:18563	*See* BNL-NUREG–60203			
Vol.3	19:18488	*See* NUREG/CP–0133-Vol.3			
CONF-931080–		(Visualization '93; San Jose, CA (United States); 25-29 Oct 1993)			
6	19:20580	*See* UCRL-JC–114300			
CONF-931095–		(Department of Energy environmental remediation conference; Augusta, GA (United States); 24-28 Oct 1993)			
81	19:18055	*See* FEMP/SUB–070			
83	19:18150	*See* WHC-SA–2112			
CONF-931107–		(1993 IEEE nuclear science symposium and medical imaging conference; San Francisco, CA (United States); 2-5 Nov 1993)			
37	19:19435	*See* BNL–60385			
CONF-931108–		(Fall meeting of the Materials Research Society (MRS); Boston, MA (United States); 29 Nov - 3 dec 1993)			
100	19:18135	*See* UCRL-JC–116132			
101	19:19102	*See* LBL–34997			
56	19:17995	*See* ANL/CMT/CP–79852			
CONF-9311136–		(Scientific conference on chemical defense research; Aberdeen Proving Ground, MD (United States); 16-19 Nov 1993)			
1	19:19230	*See* LA-UR–93-3581			
CONF-9311138–		(NOVEL laser sources and applications workshop; San Jose, CA (United States); 12-13 Nov 1993)			
2	19:19488	*See* LBL–35305			
CONF-9311157–		(Risk assessment model review workshop; Washington, DC (United States); 30 Nov - 1 dec 1993)			
1	19:19817	*See* ANL/EA/CP–81474			

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CONF-931117–		(20. international technical meeting on air pollution modelling and its application; Valencia (Spain); 29 Nov - 3 dec 1993)			
2	19:19558	*See* PNL-SA–23289			
CONF-931119–		(3. international symposium on stabilization/solidification of hazardous, radioactive and mixed wastes; Williamsburg, VA (United States); 1-5 Nov 1993)			
2	19:18199	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94002540	MF-940
CONF-9311198–		(Round Table Discussion on the Nuclear Power for the Philippines; Quezon City (Philippines); 10 Nov 1993)			
	19:18514	*See* INIS-mf–13866			
	19:18878	*See* INIS-mf–13865			
CONF-9311200–		(Two-phase flow in fractured rock; Berkeley, CA (United States); 3-5 Nov 1993)			
1	19:18087	*See* LBL–35387			
CONF-931132–		(Fall meeting of the Plasma Physics Division of the American Physical Society; St. Louis, MO (United States); 1-5 Nov 1993)			
4	19:20426	*See* UCRL-JC–114456			
CONF-931156–		(Fuels technology contractors' review meeting; Morgantown, WV (United States); 16-18 Nov 1993)			
	19:17940	*See* DOE/METC–94/1002			
CONF-931165–		(Conference on transboundary/international issues; Victoria (Canada); 8-10 Nov 1993)			
2	19:18467	*See* PNL-SA–22853			
CONF-931188–		(17. annual training resources and data exchange conference: integrating training requirements and expectations; Indianapolis, IN (United States); 15-17 Nov 1993)			
3	19:18832	*See* WHC-SA–2182			
CONF-931201–		(4. international conference on chemistry and migration behavior of actinides and fission products in the geosphere; Charleston, SC (United States); 12-17 Dec 1993)			
5	19:18083	*See* LA-UR–93-4253			
CONF-931237–		(LASERS '93: international conference on lasers and applications; Lake Tahoe, NV (United States); 6-10 Dec 1993)			
5	19:19313	*See* UCRL-JC–116324			
CONF-931265–		(Russian Academy of Sciences technical meeting; Moscow (Russian Federation); 1-3 Dec 1993)			
1	19:19509	*See* UCRL-JC–115690			
CONF-940113–		(13. Energy-sources technology conference and exhibition (ETCE) on wind energy; New Orleans, LA (United States); 23-26 Jan 1994)			
10	19:19001	*See* DOE/MC/23174–94/C0332			
CONF-940115–		(74. American Meteorological Society annual meeting; Nashville, TN (United States); 23-28 Jan 1994)			
14	19:19569	*See* UCRL-JC–115308			
16	19:19574	*See* WSRC-MS–93-502			
26	19:19555	*See* PNL-SA–23105			
27	19:20570	*See* PNL-SA–23046			
29	19:19554	*See* PNL-SA–22899			
CONF-940131–		(5. annual symposium on global change studies; Nashville, TN (United States); 24-28 Jan 1994)			
4	19:19553	*See* PNL-SA–22773			
6	19:19556	*See* PNL-SA–23162			
CONF-940136–		(27. Hawaii international conference on system sciences; Maui, HI (United States); 4-7 Jan 1994)			
2	19:20572	*See* SAND–93-2172C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-940142–		(OE/LASE '94: conference on optics, electro-optics, and laser applications in science and engineering; Los Angeles, CA (United States); 22-29 Jan 1994)			
31-Rev.1	19:19312	*See* UCRL-JC–116292-Rev.1			
34	19:19311	*See* UCRL-JC–116078			
35	19:19149	*See* LBL–35194			
36	19:19399	*See* LBL–35323			
37	19:19299	*See* LA-UR–94-1197			
CONF-940144–		(20. annual Society of Explosives Engineers meeting on explosives and blasting techniques; Austin, TX (United States); 30 Jan - 2 feb 1994)			
1	19:19173	*See* LA-UR–93-4072			
CONF-940159–		(Joint 40/50 industry outreach meeting; Seattle, WA (United States); 25-27 Jan 1994)			
1	19:20571	*See* PNL-SA–23624			
CONF-940163–		(International panel on climate change workshop on policy instruments and their implications; Tsukuba (Japan); 17-20 Jan 1994)			
1	19:19561	*See* PNL-SA–23708			
CONF-940165–		(Symmposium on hazardous materials, identification, handling and management; Arzamas-16 (Russian Federation); 25 Jan - 2 feb 1994)			
1	19:18133	*See* UCRL-JC–115724			
CONF-940169–		(10. winter workshop on nuclear dynamics; Snowbird, UT (United States); 15-21 Jan 1994)			
4	19:20008	*See* LBL–35295			
CONF-940173–		(CERN SMC meeting on internal spin structure of the nucleon; New Haven, CT (United States); 5-6 Jan 1994)			
2	19:20061	*See* DOE/ER/40150–262			
3	19:20051	*See* LA-UR–94-1300			
CONF-940178–		(2. international conference on on-site analysis and field-portable instrumentation; Houston, TX (United States); 24-26 Jan 1994)			
1	19:19580	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010123	MF-906
CONF-940179–		(Comparative and global properties conference; La Serena (Chile); 25-28 Jan 1994)			
1	19:19937	*See* LA-UR–94-1118			
CONF-940180–		(Managing the plutonium surplus: applications and options conference; London (United Kingdom); 24-25 Jan 1994)			
1	19:18263	*See* ANL/OTD-ER/CP–82305			
CONF-940182–		(Aspen winter conference on astrophysics: millisecond pulsars, a decade of surprises; Aspen, CO (United States); 3-7 Jan 1994)			
1	19:19941	*See* LBL–35277			
CONF-940183–		(22. gross properties of nuclei and nuclear excitations international workshop; Kleinwalsertal (Austria); 17-22 Jan 1994)			
1	19:20219	*See* LBL–35236			
CONF-940184–		(CTU seminar 94; Prague (Czech Republic); 17-20 Jan 1994)			
	19:20494	*See* INIS-mf–13870			
	19:20496	*See* INIS-mf–13872			
CONF-940204–		(123. annual meeting of the Minerals, Metals and Materials Society; San Francisco, CA (United States); 27 Feb - 3 mar 1994)			
7	19:18113	*See* PNL-SA–22948			
CONF-940211–		(27. midyear topical meeting of the Health Physics Society: managing radioactive and mixed waste; Albany, NY (United States); 13-17 Feb 1994)			
3	19:19637	*See* WSRC-MS–93-421			
CONF-940212–		(Seminar on developments in radioactive waste transport; Vienna (Austria); 21-25 Feb 1994)			
2	19:17989	*See* SAND–94-0698C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-940222–		(Corrosion 94: National Association of Corrosion Engineers (NACE) international annual conference; Baltimore, MD (United States); 28 Feb - 4 mar 1994)			
3	19:18166	*See* WSRC-MS–93-198			
15	19:18144	*See* WHC-SA–1982			
16	19:18145	*See* WHC-SA–1983			
CONF-940225–		(Waste management '94; Tucson, AZ (United States); 27 Feb - 3 mar 1994)			
3	19:18116	*See* RFP–4758			
4	19:18117	*See* RFP–4806			
10	19:18167	*See* WSRC-MS–93-485			
100	19:18154	*See* WHC-SA–2129			
101	19:18252	*See* WHC-SA–2130			
102	19:18149	*See* WHC-SA–2102			
103	19:18153	*See* WHC-SA–2124			
104	19:18157	*See* WHC-SA–2152			
105	19:18156	*See* WHC-SA–2143			
106	19:18147	*See* WHC-SA–2094			
11	19:18155	*See* WHC-SA–2131			
15	19:18118	*See* RFP–4807			
33	19:19624	*See* RFP–4812			
42	19:18169	*See* WSRC-MS–93-563			
47	19:19605	*See* LA-UR–94-400			
55	19:18168	*See* WSRC-MS–93-562			
83	19:18880	*See* WHC-SA–2133			
86	19:18152	*See* WHC-SA–2123			
87	19:19243	*See* WHC-SA–2341			
88	19:18254	*See* WHC-SA–2288			
CONF-940247–		(IS&T/Society of Photo-optical Instrumentation Engineers (SPIE) meeting on electronic imaging science and technology; San Jose, CA (United States); 6-10 Feb 1994)			
4	19:19606	*See* LBL–34865			
CONF-940263–		(1994 IEEE winter power meeting; New York, NY (United States); Feb 1994)			
1	19:18812	*See* PNL-SA–22883			
CONF-940275–		(Symposium on high-voltage and high-resolution electron microscopy; Stuttgart (Germany); 21-24 Feb 1994)			
1	19:19027	*See* ANL/MSD/CP–82380			
2	19:19028	*See* ANL/MSD/CP–82465			
CONF-940276–		(Energy Facility Contractors Group (EFCOG) conference; San Francisco, CA (United States); 15 Feb 1994)			
2	19:18255	*See* WHC-SA–2345			
CONF-940277–		(Atmospheric radiation measurement science team meeting; Charleston, SC (United States); 28 Feb - 3 mar 1994)			
1	19:19562	*See* PNL-SA–24063			
2	19:19566	*See* SAND–94-8597			
CONF-940301–		(207. spring national meeting of the American Chemical Society (ACS); San Diego, CA (United States); 13-18 Mar 1994)			
6	19:17825	*See* SAND–93-2615C			
26	19:18831	*See* SAND–93-2289C			
30	19:19942	*See* LBL–35438			
CONF-940307–		(International symposium on nuclear material safeguards; Vienna (Austria); 14-18 Mar 1994)			
20	19:18264	*See* BNL–49975			
21	19:18265	*See* BNL–49979			
25	19:18266	*See* BNL–60131			
CONF-9403100–		(Advanced satellite for cosmology and astrophysics symposium; Tokyo (Japan); 8-11 Mar 1994)			
1	19:19945	*See* UCRL-JC–116866			
CONF-9403106–		(Vehicle thermal management systems conference; Columbus, OH (United States); 29 Mar - 1 apr 1994)			
1	19:19012	*See* NREL/TP–432-5028			

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CONF-9403108–		(Post-graduate course in veterinary oncology; Santiago (Chile); 22-24 Mar 1994)			
1	19:19806	*See* PNL-SA–23750			
5	19:19805	*See* PNL-SA–23734			
6	19:19804	*See* PNL-SA–23733			
2-Rev.2	19:19791	*See* PNL-SA–16357-Rev.2			
3-Rev.1	19:19803	*See* PNL-SA–17044-Rev.1			
CONF-9403109–		(29. annual veterinary symposium; Tuskegee, AL (United States); 28-30 Mar 1994)			
1	19:19784	*See* PNL-SA–23976			
CONF-9403110–		(21. American Meteorological Society conference on agricultural and forest meteorology; 11. biometeorology and aerobiology conference; San Diego, CA (United States); San Diego, CA (United States); 7-10 Mar 1994; 7-10 mar 1994)			
1	19:19560	*See* PNL-SA–23484			
CONF-9403111–		(Electric Power Research Institute (EPRI) EMF seminar on focus on research; Santa Clara, CA (United States); 14-16 Mar 1994)			
1	19:19910	*See* PNL-SA–23995			
CONF-9403112–		(1994 energy and environmental management conference; Tysons Corner, VA (United States); 9 Mar - 10 sep 1994)			
1	19:18928	*See* PNL-SA–23880			
CONF-9403115–		(Substorms; Fairbanks, AL (United States); 7-11 Mar 1994)			
1	19:19938	*See* LA-UR–94-1378			
2	19:19939	*See* LA-UR–94-1379			
CONF-9403116–		(ICS2 conference; Fairbanks, AK (United States); 7-11 Mar 1994)			
1	19:19940	*See* LA-UR–94-1455			
CONF-940312–		(2. Probabilistic safety assessment and management conference (PSAM); San Diego, CA (United States); 20-24 Mar 1994)			
55-Rev.1	19:18260	*See* WSRC-MS–93-277-Rev.1			
CONF-940316–		(International symposium on spin-isospin response and weak processes in hadrons and nuclei; Osaka (Japan); 8-10 Mar 1994)			
1	19:20066	*See* ANL/PHY/CP–82606			
2	19:20214	*See* LA-UR–94-1178			
CONF-940335–		(Gas supply planning, control and deliverability under Order 636; Houston, TX (United States); 7-9 Mar 1994)			
1	19:20605	*See* PNL-SA–22430			
CONF-940353–		(Symposium on the application of geophysics to environmental and engineering problems; Boston, MA (United States); 27-31 Mar 1994)			
1	19:19633	*See* UCRL-JC–116144			
2	19:19632	*See* UCRL-JC–115362			
CONF-940362–		(21. American Meteorological Society conference on agricultural and forest meteorology; 11. biometeorology and aerobiology conference; San Diego, CA (United States); San Diego, CA (United States); 7-10 Mar 1994; 7-10 mar 1994)			
3	19:19560	*See* PNL-SA–23484			
4	19:19559	*See* PNL-SA–23405			
CONF-940375–		(Office for Economic Cooperation and Development/Nuclear Energy Agency workshop on large molten pool heat transfer; Grenoble (France); 9-11 Mar 1994)			
1	19:18805	*See* SAND–94-0376C			
CONF-940380–		(National Institute for Research in Inorganic Materials (NIRIM) symposium on advanced materials; Tsukuba (Japan); 13-17 Mar 1994)			
2	19:19080	*See* UCRL-JC–115980			
CONF-940391–		(Society of Photo-Optical Instrumentation Engineers (SPIE) conference; Kona Beach, HI (United States); 13-18 Mar 1994)			
4	19:19489	*See* SAND–94-0577C			

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5	19:19486	*See* LBL–34446			
CONF-940395–		(Astronomical telescopes and instrumentation for the 21st century; Kona Beach, HI (United States); 13-18 Mar 1994)			
1	19:19492	*See* UCRL-JC–116505			
CONF-940397–		(25. international symposium on combustion; Wester States section of the Combustion Institute spring meeting; Irvine, CA (United States); Davis, CA (United States); 31 Jul - 5 aug 1994; 21-22 mar 1994)			
1	19:19176	*See* SAND–94-8484C			
2	19:19174	*See* LBL–35318			
CONF-940402–		(International topical meeting on the safety of advanced reactors; Pittsburgh, PA (United States); 18-20 Apr 1994)			
6	19:18757	*See* ANL/RA/CP–79958			
7	19:18758	*See* ANL/RA/CP–79959			
8	19:18762	*See* ANL/RA/CP–80023			
9	19:18804	*See* SAND–93-2200C			
10	19:18759	*See* ANL/RA/CP–80012			
11	19:18764	*See* ANL/RA/CP–80139			
12	19:18756	*See* ANL/RA/CP–79957			
14	19:18761	*See* ANL/RA/CP–80014			
15	19:18760	*See* ANL/RA/CP–80013			
16	19:18765	*See* ANL/RA/CP–80293			
17	19:18763	*See* ANL/RA/CP–80137			
20	19:18536	*See* ANL/ET/CP–80062			
24	19:18490	*See* SAND–93-1833C			
CONF-940406–		(International symposium on decontamination and decommissioning; Knoxville, TN (United States); 27-29 Apr 1994)			
1	19:18251	*See* WHC-SA–1979			
2	19:18000	*See* ANL/DIS/CP–82018			
5	19:18755	*See* ANL/EWM/VU–82273			
7	19:18179	*See* Y/EN–5214			
8	19:18256	*See* WHC-SA–2372			
CONF-940407–		(Topical meeting on advances in reactor physics; Knoxville, TN (United States); 11-14 Apr 1994)			
5	19:18623	*See* ANL/RA/CP–80768			
16	19:18639	*See* ANL/TD/CP–82235			
18	19:18290	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010121	MF-410
19	19:18582	*See* LA-UR–94-1284			
CONF-9404102–		(12. geothermal program review: geothermal's role in global climate change - impacts on the Climate Change Action Plan; San Francisco, CA (United States); 25-28 Apr 1994)			
1	19:18387	*See* SAND–94-0949C			
2	19:18396	*See* BNL–60326			
CONF-9404107–		(New Mexico conference on the environment; Albuquerque, NM (United States); 24-26 Apr 1994)			
2	19:18849	*See* LA-UR–94-705			
CONF-940411–		(Spring meeting of the Materials Research Society; San Francisco, CA (United States); 4-8 Apr 1994)			
7	19:19078	*See* SAND–93-2547C			
8	19:19077	*See* SAND–93-2546C			
9	19:19302	*See* SAND–93-2617C			
11	19:19059	*See* ANL/MSD/CP–81222			
12	19:19161	*See* SAND–94-0493C			
13	19:19049	*See* SAND–93-2711C			
14	19:19074	*See* LA-UR–94-1316			
15	19:19029	*See* ANL/MSD/CP–82716			
16	19:19086	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011468	MF-404
CONF-9404110–		(3. FedUNIX annual conference on system administration, networking, and security; Washington, DC (United States); 4-9 Apr 1994)			
2	19:19021	*See* SAND–94-0154C			

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CONF-9404113–		(Nuclear weapons complex software quality assurance forum; Livermore, CA (United States); 18-20 Apr 1994)			
1	19:19511	*See* SAND–94-0695C			
CONF-9404114–		(10. Performance Management Association (PMA) annual conference; San Antonio, TX (United States); 20-22 Apr 1994)			
1	19:18198	*See* ANL/EA/CP–80790			
CONF-9404118–		(International Society for Hybrid multichip modules; Denver, CO (United States); 13-15 Apr 1994)			
2	19:19303	*See* SAND–93-2778C			
CONF-9404126–		(Workshop on effects of chromium coating on Nb_3sn superconductor strand; Livermore, CA (United States); 12 Apr 1994)			
	19:20431	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94012135	MF-423
CONF-9404130–		(Argonne quality awareness (QA) day; Argonne, IL (United States); 7 Apr 1994)			
2	19:18001	*See* ANL/EQO/CP–82406			
CONF-9404131–		(American Society for Precision Engineering (ASPE) conference; Tucson, AZ (United States); 6-8 Apr 1994)			
1	19:19493	*See* UCRL-JC–116931			
2	19:19240	*See* UCRL-JC–116932			
CONF-9404132–		(Non-proliferation experiment (NPE); Washington, DC (United States); 19-21 Apr 1994)			
1	19:19020	*See* LA-UR–94-988			
CONF-9404133–		(Society of Manufacturing Engineers (SME) rapid prototyping and manufacturing '94 conference; Dearborn, MI (United States); 26-28 Apr 1994)			
1	19:19050	*See* SAND–93-3862C			
CONF-9404134–		(Korean Atomic Industrial Forum/Korean Nuclear Society (KAIF/KNS) meeting; Seoul (Korea, Republic of); 6-8 Apr 1994)			
1	19:18272	*See* LA-UR–94-887			
CONF-9404135–		(5. international symposium on high power lasers and applications; Vienna (Austria); 5-8 Apr 1994)			
1	19:19298	*See* LA-UR–94-802			
2	19:19314	*See* UCRL-JC–117000			
CONF-9404136–		(Operations Research Society of America conference; Boston, MA (United States); 12-17 Apr 1994)			
1	19:20507	*See* ANL/RA/CP–82382			
CONF-9404137–		(12. symposium on energy engineering sciences; Argonne, IL (United States); 27-29 Apr 1994)			
1	19:19252	*See* ANL/ET/CP–82379			
CONF-9404138–		(Workshop at suburban library on INTERNET; Burr Ridge, IL (United States); 26 Apr 1994)			
1-Vugraphs	19:20585	*See* ANL/IPD/CP–82431			
CONF-9404143–		(Oracle CAS SIG spring '94 conference; Keystone, CO (United States); 23-26 Apr 1994)			
1	19:20583	*See* WHC-SA–2086			
CONF-9404144–		(International Energy Agency fatigue experts meeting; Bergen aan Zee (Netherlands); 21-22 Apr 1994)			
1	19:18420	*See* SAND–94-1078C			
CONF-9404145–		(New Mexico High Tech Crime Investigation Association conference; Albuquerque, NM (United States); 28 Apr 1994)			
1	19:20574	*See* SAND–94-1213C			
CONF-9404147–		(Department of Energy fire protection conference; Albuquerque, NM (United States); 11-15 Apr 1994)			
1	19:18494	*See* WHC-SA–2333			
CONF-940416–		(96. annual meeting of the American Ceramic Society; Indianapolis, IN (United States); 24-28 Apr 1994)			
3	19:19104	*See* SAND–93-2048C			
4	19:18002	*See* ANL/ET/CP–81294			

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5	19:17999	*See* ANL/CMT/CP–81265			
6	19:17998	*See* ANL/CMT/CP–81229			
7	19:17997	*See* ANL/CMT/CP–81047			
8	19:18961	*See* ANL/ET/CP–81295			
CONF-940424–		(8. international conference on radiation shielding; Arlington, TX (United States); 24-27 Apr 1994)			
27	19:19239	*See* UCRL-JC–116305			
CONF-940433–		(Spring meeting of the American Institute of Chemical Engineers; Atlanta, GA (United States); 17-21 Apr 1994)			
2	19:17938	*See* DOE/MC/28133–94/C0336			
3	19:19155	*See* SAND–93-2070C			
4	19:17891	*See* DOE/METC/C–94/7125			
CONF-940436–		(4. international meeting on nuclear thermal hydraulics, operations and safety; Taipei (Taiwan, Province of China); 3-6 Apr 1994)			
5	19:18539	*See* ANL/RA/CP–80315			
6	19:18538	*See* ANL/RA/CP–80314			
CONF-940437–		(International seminar on health effects of radium and thorium; Heidelberg (Germany); 18-22 Apr 1994)			
1	19:19821	*See* ANL/ER/CP–81143			
2	19:19818	*See* ANL/ER/CP–80985			
3	19:19819	*See* ANL/ER/CP–81045			
4	19:19820	*See* ANL/ER/CP–81061			
CONF-940440–		(International conference on metallurgical coatings and thin films; San Diego, CA (United States); 25-29 Apr 1994)			
1	19:19301	*See* SAND–93-2510C			
2	19:19057	*See* ANL/ET/CP–81839			
CONF-940445–		(56. annual American power conference; Chicago, IL (United States); 25-27 Apr 1994)			
4	19:18585	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010129	
5	19:18903	*See* DOE/MC/28055–94/C0334			
CONF-940449–		(Society of Photo-Optical Instrumentation Engineers conference on intelligent information systems; Orlando, FL (United States); 4-8 Apr 1994)			
6	19:19501	*See* UCRL-JC–115251			
8	19:19779	*See* LBL–35281			
CONF-940456–		(1994 Society for Computer Simulation multiconference; San Diego, CA (United States); 11-15 Apr 1994)			
17	19:18158	*See* WHC-SA–2159			
19	19:19055	*See* UCRL-JC–115857			
4-Rev.1	19:19110	*See* WSRC-MS–93-551-Rev.1			
9-Pt.2	19:19639	*See* WSRC-MS–94-082			
CONF-940482–		(American Nuclear Society (ANS) topical meeting; Topical meeting on advances in reactor physics; Knoxville, TN (United States); Knoxville, TN (United States); 11-15 Apr 1994; 11-14 apr 1994)			
3	19:18582	*See* LA-UR–94-1284			
CONF-940499–		(Federal environmental restoration and waste minimization conference and exhibition; New Orleans, LA (United States); 25-29 Apr 1994)			
1	19:18230	*See* LA-UR–94-846			
7	19:19573	*See* WHC-SA–2269			
9	19:18159	*See* WHC-SA–2300			
CONF-940503–		(Annual meeting of the Society of Tribologists and Lubrication Engineers; Pittsburgh, PA (United States); 2-5 May 1994)			
1	19:19096	*See* DOE/NASA–50306-4			
CONF-940507–		(International conference on nuclear data for science and technology; Gatlinburg, TN (United States); 9-13 May 1994)			
3	19:20217	*See* LA-UR–94-1471			
4	19:20098	*See* LA-UR–94-1440			
5	19:20216	*See* LA-UR–94-1377			
6	19:20238	*See* ANL/TD/CP–81180			

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Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
7	19:18085	*See* LA-UR–94-1351			
CONF-9405100–		(Scalable high performance computing conference; Knoxville, TN (United States); 23 May 1994)			
2	19:20530	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011460	MF-405
3	19:20503	*See* ANL/MCS/CP–82804			
4	19:20502	*See* ANL/MCS/CP–82803			
CONF-9405109–		(Department of Energy defense programs packaging workshop; Knoxville, TN (United States); 16-19 May 1994)			
1	19:19245	*See* WSRC-TR–94-0155			
4	19:19244	*See* WSRC-MS–94-0199			
5	19:19234	*See* SAND–93-2645C			
CONF-9405111–		(16. Department of Energy computer security group training conference; Denver, CO (United States); 3-5 May 1994)			
	19:20531	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009967	MF-900
CONF-9405112–		(1994 Institute of Electrical and Electronics Engineers (IEEE) microwave theory technique symposium; San Diego, CA (United States); 23-27 May 1994)			
2	19:19309	*See* SAND–94-0709C			
CONF-9405121–		(45. annual international appliance tecchnical conference; Madison, WI (United States); 9-11 May 1994)			
1	19:19091	*See* DOE/CE/23810–40A			
2	19:19092	*See* DOE/CE/23810–40B			
CONF-9405123–		(15. conference on advances in the production of tubes, bars and shapes; Clearwater, FL (United States); 2-3 May 1994)			
1	19:18537	*See* ANL/ET/CP–80384			
CONF-9405124–		(Electric Power Research Institute (EPRI) fluidized-bed combustion for power generation conference; Atlanta, GA (United States); 17-19 May 1994)			
1	19:17890	*See* DOE/MC/27364–94/C0337			
2	19:17888	*See* DOE/MC/24132–94/C0335			
CONF-9405125–		(4. conference on computer generated forces and behavioral representation; Orlando, FL (United States); 4-6 May 1994)			
1	19:19502	*See* UCRL-JC–115914			
CONF-9405126–		(EG&G GOCO environmental conference; Las Vegas, NV (United States); 10-12 May 1994)			
2	19:17991	*See* RFP–4829			
3	19:18120	*See* RFP-ADD–0029			
CONF-9405127–		(Atomic RF techniques spring conference; San Diego, CA (United States); 27 May 1994)			
1	19:19308	*See* SAND–94-0575C			
CONF-9405128–		(International conference on progress and applications of plasma focus research; Hoboken, NJ (United States); 27 May 1994)			
1	19:20423	*See* SAND–94-0934C			
CONF-9405130–		(2. Chilean lithium symposium; Santiago (Chile); 24-27 May 1994)			
1	19:20429	*See* ANL/CMT/CP–82686			
CONF-9405132–		(14. international conference on few body problems in physics; Williamsburg, VA (United States); 26-31 May 1994)			
1	19:20123	*See* ANL/PHY/CP–82591			
2	19:20215	*See* LA-UR–94-1264			
3	19:20052	*See* LBL–35316			
CONF-9405134–		(Ozone, sun, cancer symposium; Paris (France); 17-20 May 1994)			
1	19:19816	*See* ANL/CMB/SUMM–82561			
CONF-9405136–		(1994 joint USA-Russia energetic material technology symposium; Livermore, CA (United States); 18-25 May 1994)			
1	19:19507	*See* SAND–94-1224C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9405140–		(Annual meeting of the American Crystallographic Association; Albuquerque, NM (United States); 24-28 May 1994)			
1	19:18289	*See* ANL/MSD/CP–82631			
CONF-9405143–		(8. annual conference on fossil energy materials; Oak Ridge, TN (United States); 10-12 May 1994)			
1	19:19024	*See* ANL/ET/CP–82282			
2	19:19023	*See* ANL/ET/CP–82281			
CONF-940518–		(International conference on nuclear systems thermal hydraulics; Pisa (Italy); 30 May - 2 jun 1994)			
2	19:18767	*See* BNL–49863			
CONF-940528–		(Incineration conference: 13th international symposium on thermal treatment technologies; Houston, TX (United States); 9-13 May 1994)			
1	19:18176	*See* WSRC-TR–94-0091			
CONF-940529–		(185. Electrochemical Society meeting; San Francisco, CA (United States); 22-27 May 1994)			
5	19:19126	*See* ANL/MSD/CP–82168			
CONF-940552–		(10. topical conference on high-temperature plasma diagnostics; Rochester, NY (United States); 8-12 May 1994)			
1	19:20467	*See* SAND–94-1300C			
2	19:20427	*See* UCRL-JC–116184			
3	19:20466	*See* SAND–94-0329C			
CONF-940553–		(International high-level radioactive waste management conference; Las Vegas, NV (United States); 22-26 May 1994)			
4	19:19281	*See* DOE/NV/11432–1			
8	19:18122	*See* SAND–93-2240C			
9	19:18134	*See* UCRL-JC–115798			
12	19:18123	*See* SAND–94-0138C			
29	19:18148	*See* WHC-SA–2100			
34	19:19242	*See* WHC-SA–2007			
36	19:17996	*See* ANL/CMT/CP–80979			
37	19:18119	*See* RFP–4835			
38	19:19247	*See* Y/NA–1784			
CONF-940582–		(CLEO '94: conference on lasers and electro-optics; Anaheim, CA (United States); 8-13 May 1994)			
3	19:19310	*See* UCRL-JC–115945			
CONF-940593–		(9. international conference on ultrafast phenomena; Dana Point, CA (United States); 1-5 May 1994)			
6	19:18352	*See* ANL/CHM/CP–81874			
8	19:18353	*See* ANL/CHM/CP–81875			
9	19:18354	*See* ANL/CHM/CP–81878			
10	19:18351	*See* ANL/CHM/CP–81873			
CONF-940602–		(35. annual meeting of the American Nuclear Society; 11. topical meeting on the technology of fusion energy; New Orleans, LA (United States); New Orleans, LA (United States); 11-16 Jun 1994; 19-24 jun 1994)			
3	19:18243	*See* RFP–4799			
4	19:18584	*See* BNL-NUREG–49996			
5	19:18640	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009166	MF-405
6	19:18811	*See* Y/DD–626			
7	19:19246	*See* Y/DD–613/R1			
8	19:18583	*See* WAPD-T–3030			
CONF-9406116–		(Optical Society of America meeting on diffractive optics: design, fabrication and applications; Rochester, NY (United States); 6-8 Jun 1994)			
4	19:17951	*See* UCRL-JC–116056			
CONF-9406126–		(1994 joint Instrument Society of America and Electric Power Research Institute conference; Orlando, FL (United States); 5-8 Jun 1994)			
1	19:18497	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007207	MF-400

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-940613–		(Pressure vessel and piping conference; Minneapolis, MN (United States); 19-23 Jun 1994)			
5	19:18151	*See* WHC-SA–2118			
6	19:19241	*See* UCRL-JC–116948			
7	19:19031	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010128	
9	19:18005	*See* BNL–49761			
CONF-9406130–		(9. annual conference on computer assurance; Gaithersburg, MD (United States); 27-30 Jun 1994)			
1	19:18808	*See* UCRL-JC–116038			
CONF-9406132–		(ABAQUS User's conference; Newport, RI (United States); 1-3 Jun 1994)			
1	19:19236	*See* SAND–94-0742C			
CONF-9406133–		(1994 American control conference; Baltimore, MD (United States); 29 Jun - 1 jul 1994)			
1	19:19022	*See* SAND–94-0783C			
CONF-9406153–		(Rocky Mountain quality conference; Denver, CO (United States); 12-14 Jun 1994)			
1	19:20498	*See* RFP–4795			
CONF-9406155–		(AWRA annual summer symposium; Jackson Hole, WY (United States); 26-29 Jun 1994)			
1	19:19666	*See* WHC-SA–1989			
CONF-9406160–		(National Aeronautics and Space Administration (NASA) symposium on neural fuzzy logic; San Diego, CA (United States); 9-10 Jun 1994)			
1	19:20575	*See* SAND–94-1347C			
CONF-9406162–		(10. annual symposium on computational geometry; Stony Brook, NY (United States); 6-8 Jun 1994)			
1	19:20573	*See* SAND–94-1045C			
CONF-940618–		(4. European particle accelerator conference; London (United Kingdom); 27 Jun - 1 jul 1994)			
1	19:19329	*See* BNL–49799			
2	19:19330	*See* BNL–49800			
CONF-940625–		(6. AIAA/ASME thermophysics and heat transfer conference; Colorado Springs, CO (United States); 20-23 Jun 1994)			
3	19:18911	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009169	MF-350
CONF-940629–		(6. joint conference on magnetism and magnetic materials; Albuquerque, NM (United States); 20-23 Jun 1994)			
3	19:19026	*See* ANL/MSD/CP–82160			
CONF-940630–		(35. annual meeting of the American Nuclear Society; 11. topical meeting on the technology of fusion energy; New Orleans, LA (United States); New Orleans, LA (United States); 11-16 Jun 1994; 19-24 jun 1994)			
2	19:18243	*See* RFP–4799			
CONF-940632–		(Annual meeting and exhibition of the Air and Waste Management Association; Cincinnati, OH (United States); 19-24 Jun 1994)			
5	19:19638	*See* WSRC-MS–94-064			
7	19:19571	*See* UCRL-JC–116485			
8	19:19908	*See* ANL/EA/CP–82328			
9	19:18253	*See* WHC-SA–2264			
10	19:19572	*See* UCRL-JC–116526			
11	19:18443	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010272	MF-105
CONF-940633–		(12. symposium on thermophysical properties; Boulder, CO (United States); 19-24 Jun 1994)			
2	19:19150	*See* LBL–35354			
CONF-940650–		(10. annual conference and exposition of the National Association of Environmental Professionals: global strategies for environmental issues; New Orleans, LA (United States); 12-15 Jun 1994)			
1	19:19500	*See* SAND–94-0748C			

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CONF-940651--		(International workshop on superconductivity: critical current of high-temperature superconductors and related topics; Kyoto (Japan); 6-9 Jun 1994)			
1	19:19075	*See* LA-UR-94-1417			
CONF-940659--		(1994 ASME (Americal Society of Mechanical Engineers) fluids engineering summer meeting; Lake Tahoe, NV (United States); 19-23 Jun 1994)			
5	19:18810	*See* WSRC-MS-94-0131			
CONF-940670--		(36. power sources conference; Cherry Hill, NJ (United States); 6-9 Jun 1994)			
1	19:19505	*See* SAND-93-2732C			
2	19:18826	*See* SAND-93-2785C			
CONF-940711--		(25. international symposium on combustion; Irvine, CA (United States); 31 Jul - 5 aug 1994)			
1	19:19175	*See* SAND-94-8483C			
2	19:19176	*See* SAND-94-8484C			
3	19:19178	*See* SAND-94-8510C			
4	19:18769	*See* BNL-NUREG-49797			
5	19:19006	*See* UCRL-JC-115804			
6	19:19157	*See* UCRL-JC-115802			
7	19:17901	*See* SAND-94-8480			
8	19:17902	*See* SAND-94-8485			
9	19:17842	*See* SAND-94-8481			
10	19:18318	*See* SAND-94-8482			
11	19:17944	*See* UCRL-JC-115803			
12	19:19181	*See* UCRL-JC-115807			
13-Rev.1	19:19508	*See* UCRL-JC-114201-Rev.1			
CONF-940719--		(World congress on computational and applied mathematics; Atlanta, GA (United States); 11-15 Jul 1994)			
1	19:19290	*See* LA-UR-94-1238			
CONF-940725--		(International conference on hypernuclear and strange particle physics; Vancouver (Canada); 4-8 Jul 1994)			
1	19:20050	*See* LA-UR-94-1175			
CONF-940726--		(31. annual international nuclear and space radiation effects conference; Tucson, AZ (United States); 18-22 Jul 1994)			
1	19:19485	*See* SAND-94-0532C			
2	19:19307	*See* SAND-94-0459C			
3	19:19484	*See* SAND-94-0457C			
4	19:19305	*See* SAND-94-0447C			
5	19:19306	*See* SAND-94-0458C			
6	19:19481	*See* SAND-94-0367C			
7	19:19482	*See* SAND-94-0382C			
8	19:19483	*See* SAND-94-0448C			
9	19:19432	*See* BNL-60072			
CONF-940734--		(ICLASS 94: International conference on liquid atomization and spray systems; Rouen (France); 18-22 Jul 1994)			
1	19:19177	*See* SAND-94-8493C			
CONF-940742--		(Computational methods in water resources; Heidelberg (Germany); 19-22 Jul 1994)			
1	19:19920	*See* LA-UR-94-418			
2	19:19282	*See* LA-UR-94-419			
4	19:19285	*See* UCRL-JC-115897			
5	19:19545	*See* LBL-35224			
CONF-940743--		(Siggraph '94; Orlando, FL (United States); 24-29 Jul 1994)			
1	19:19570	*See* UCRL-JC-115654			
CONF-940744--		(10. international zeolite conference; Garmish-Partenkirchen (Germany); 17-22 Jul 1994)			
1	19:19083	*See* BNL-60041			
2	19:19147	*See* LA-UR-94-491			

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CONF-940749–		(3. annual American Institute of Aeronautics and Astronautics/Ballistic Missile Defense Office intercepton technology conference; San Diego, CA (United States); 12-14 Jul 1994)			
1	19:19235	*See* SAND–93-3894C			
CONF-940752–		(5. U.S. national conference on earthquake engineering; Chicago, IL (United States); 10-14 Jul 1994)			
1	19:19912	*See* UCRL-JC–116348			
CONF-940753–		(Microscopy Society of America and Microbeam Analysis Society joint meeting; New Orleans, LA (United States); 31 Jul - 5 aug 1994)			
1	19:19108	*See* SAND–94-0732C			
2	19:20300	*See* SAND–94-0776C			
3	19:19066	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011463	MF-364
4	19:19067	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011464	MF-364
5	19:19087	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011469	MF-404
CONF-940766–		(13. international congress on electron microscopy; Paris (France); 17-22 Jul 1994)			
2	19:19115	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011470	MF-404
CONF-940771–		(International symposium on fracture and strength of solids; Xian (China); 4-8 Jul 1994)			
1	19:19107	*See* SAND–94-0247C			
CRIE-Y–					
93002	19:18956	OSTI; NTIS; Available from Central Research Inst. of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, Japan		DE94767988	
CSNAS–					
0066.	19:19579	*See* CNIC–00696			
0067.	19:19799	*See* CNIC–00708			
0068.	19:19652	*See* CNIC–00715			
CSTS–					
52-94	19:18872	*See* CONF-9210428–			
CWP–					
142P	19:20534	*See* DOE/ER/14079–30			
DESY–					
93-013	19:19947	OSTI; NTIS (US Sales Only); INIS		DE94766580	
93-096	19:20019	OSTI; NTIS (US Sales Only); INIS		DE94766583	
93-099	19:20020	OSTI; NTIS (US Sales Only); INIS		DE94769252	
93-142	19:19923	OSTI; NTIS (US Sales Only); INIS		DE94768984	
93-147	19:19992	OSTI; NTIS (US Sales Only); INIS		DE94768983	
93-150	19:19993	OSTI; NTIS (US Sales Only); INIS		DE94769251	
93-158	19:20021	OSTI; NTIS (US Sales Only); INIS		DE94768982	
93-160	19:20022	OSTI; NTIS (US Sales Only); INIS		DE94768974	
93-162	19:20060	OSTI; NTIS (US Sales Only); INIS		DE94768958	
93-163	19:20023	OSTI; NTIS (US Sales Only); INIS		DE94769018	
93-164	19:19974	OSTI; NTIS (US Sales Only); INIS		DE94768957	
93-165	19:19994	OSTI; NTIS (US Sales Only); INIS		DE94769089	
93-167	19:19440	OSTI; NTIS (US Sales Only); INIS		DE94768956	
93-168	19:20024	OSTI; NTIS (US Sales Only); INIS		DE94769017	
93-175	19:20532	OSTI; NTIS (US Sales Only)		DE94769009	
93-176	19:19441	OSTI; NTIS (US Sales Only); INIS		DE94769008	
93-177	19:19975	OSTI; NTIS (US Sales Only); INIS		DE94768955	
93-178	19:19995	OSTI; NTIS (US Sales Only); INIS		DE94769006	
93-179	19:20025	OSTI; NTIS (US Sales Only); INIS		DE94769087	
93-180	19:19996	OSTI; NTIS (US Sales Only); INIS		DE94769005	
93-181	19:19997	OSTI; NTIS (US Sales Only); INIS		DE94769090	
93-182	19:20026	OSTI; NTIS (US Sales Only); INIS		DE94769081	
93-183	19:20027	OSTI; NTIS (US Sales Only); INIS		DE94769002	
93-184	19:19976	OSTI; NTIS (US Sales Only); INIS		DE94769004	
93-186	19:20028	OSTI; NTIS (US Sales Only); INIS		DE94769003	
93-187	19:20029	OSTI; NTIS (US Sales Only); INIS		DE94769083	
93-188	19:20030	OSTI; NTIS (US Sales Only); INIS		DE94769084	
93-189	19:19413	OSTI; NTIS (US Sales Only); INIS		DE94769092	
93-190	19:20031	OSTI; NTIS (US Sales Only); INIS		DE94769093	
93-191	19:19977	OSTI; NTIS (US Sales Only); INIS		DE94769082	
93-192	19:20032	OSTI; NTIS (US Sales Only); INIS		DE94768908	
93-194	19:19998	OSTI; NTIS (US Sales Only); INIS		DE94769085	
93-195	19:19999	OSTI; NTIS (US Sales Only); INIS		DE94769080	
93-197	19:20033	OSTI; NTIS (US Sales Only); INIS		DE94768906	
93-198	19:19414	OSTI; NTIS (US Sales Only); INIS		DE94769078	

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93-201	19:19442	OSTI; NTIS (US Sales Only); INIS		DE94769079	
94-003	19:19443	OSTI; NTIS (US Sales Only); INIS		DE94769019	
94-004	19:20034	OSTI; NTIS (US Sales Only); INIS		DE94768947	
94-005	19:20035	OSTI; NTIS (US Sales Only); INIS		DE94768954	
94-006	19:20000	OSTI; NTIS (US Sales Only); INIS		DE94768953	
94-007	19:19978	OSTI; NTIS (US Sales Only); INIS		DE94768952	
94-008	19:20036	OSTI; NTIS (US Sales Only); INIS		DE94768951	
94-009	19:20037	OSTI; NTIS (US Sales Only); INIS		DE94768950	
94-010	19:20038	OSTI; NTIS (US Sales Only); INIS		DE94768949	
94-011	19:20039	OSTI; NTIS (US Sales Only); INIS		DE94768917	
94-014	19:20001	OSTI; NTIS (US Sales Only); INIS		DE94768915	
94-015	19:20040	OSTI; NTIS (US Sales Only); INIS		DE94768914	
94-016	19:20041	OSTI; NTIS (US Sales Only); INIS		DE94768912	
94-017	19:20002	OSTI; NTIS (US Sales Only); INIS		DE94768911	
94-019	19:19924	OSTI; NTIS (US Sales Only); INIS		DE94768910	
94-023	19:20042	OSTI; NTIS (US Sales Only); INIS		DE94768909	
DOE–					
94011930	19:18267	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011930	MF-906
DOE/AL/62350–					
10F	19:18008	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004829	MF-902
110	19:18211	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011043	MF-902
111D	19:18212	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011034	MF-902
115	19:18213	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011035	MF-902
117	19:18214	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011040	MF-902
118	19:18215	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011039	MF-902
122	19:18216	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011037	MF-902
36-Rev.1	19:18009	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011032	MF-902
40F-Attach.2	19:18200	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011048	MF-902
40F-Attach.3-4	19:18201	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011041	MF-902
40F-Attach.3-App.A	19:18202	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011049	MF-902
48F-Rev.1	19:18203	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011038	MF-903
57D	19:18204	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004831	MF-903
57D-Rev.1	19:18205	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011033	MF-903
61	19:18206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004833	MF-903
72D	19:18207	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011045	MF-906
76-Rev.5	19:18208	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004836	MF-902
77	19:18209	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011047	MF-902
95D	19:18210	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011046	MF-902
DOE/AL/65030–					
9328	19:19287	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010664	PC-706
DOE/AL/65779–					
1	19:19527	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010787	MF-902
DOE/AN/ACNT–					
93A	19:18268	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010151	MF-900
93B	19:19016	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010152	MF-900
94A	19:19018	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010308	MF-900
DOE/BC/14650–					
15	19:17908	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000128	PC-122
DOE/BC/14655–					
8	19:17906	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000118	PC-122
DOE/BC/14658–					
9	19:17909	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000124	PC-122
DOE/BC/14659–					
T6	19:17910	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012174	MF-122
T8	19:17911	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012176	MF-122
DOE/BC/14660–					
11	19:17912	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000122	PC-122
DOE/BC/14663–					
9	19:17913	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003389	MF-122
11	19:17914	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000114	PC-122
DOE/BC/14862–					
2	19:17915	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003385	MF-122
DOE/BC/14875–					
1	19:17916	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004302	MF-122
DOE/BP/01466–					
2	19:18342	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005640	MF-902
DOE/BP/01483–					
3	19:18343	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002337	MF-908
DOE/BP/17622–					
7	19:18344	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002336	MF-902

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DOE/BP/25885–					
4	19:18345	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005628	MF-902
5	19:18346	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005641	MF-902
DOE/CE/15489–					
T10	19:18962	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010223	MF-316
DOE/CE/15553–					
T5	19:17917	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003999	MF-250
DOE/CE/23810–					
20A	19:19088	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009995	MF-350
20B	19:19089	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009996	MF-350
25	19:19528	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009997	MF-350
38B	19:19090	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010426	MF-366
38E	19:18912	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011018	MF-350
40A	19:19091	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010001	MF-366
40B	19:19092	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010002	MF-366
DOE/CE/34025–					
T12	19:19909	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010192	MF-220
DOE/CH–					
9204	19:19581	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003661	MF-902
9208	19:19582	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004325	MF-902
DOE/CH/10435–					
T15	19:19008	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010576	MF-336
DOE/DP–					
0122T	19:19498	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010323	MF-700
DOE/EA–					
0339-Rev.1	19:18217	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011036	MF-902
0466	19:18834	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004391	MF-702
0532	19:18835	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004388	MF-702
0688	19:18010	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004377	MF-630
0837	19:18182	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010401	MF-630
0857	19:18817	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004386	MF-630
0872	19:18815	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004381	MF-630
0898	19:19346	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010400	MF-630
0908	19:18183	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010354	MF-630
0912	19:17968	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94012128	MF-630
0915	19:18011	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010370	MF-630
887-1	19:18836	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010470	MF-630
887-2	19:18837	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010471	MF-630
887-3	19:18838	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010472	MF-630
DOE/EE–					
0012	19:19529	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010658	MF-310
0016	19:18881	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010599	MF-350
DOE/EH–					
0256T-Rev.1	19:19840	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010322	MF-607
0351	19:18016	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011415	MF-600
0370T	19:18218	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011225	MF-607
0374	19:18844	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010372	MF-600
0376	19:20484	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011226	MF-600
231-010/1291	19:18839	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008203	MF-630
231-012b/0593	19:17932	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010117	MF-600
231-013/0494	19:18012	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012044	MF-610
231-018/1093	19:18840	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008198	MF-630
231-020/0394	19:18841	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010146	MF-600
231-037/0494	19:18013	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012045	MF-610
231-038/0494	19:18014	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012046	MF-630
231-040/1093	19:18842	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002601	PC-630
231-043/0394	19:18015	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010363	PC-630
231-044/0394	19:18843	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012047	MF-630
94010351	19:17969	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010351	MF-600
94010352	19:17970	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010352	MF-600
DOE/EIA–					
0035(94/04)	19:18892	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE94010329	MF-950
0109(94/04)	19:17928	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94011228	MF-950
0130(94/04)	19:17942	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94010518	MF-950
0202(94/2Q)	19:18882	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94011022	MF-950
0226(94/04)	19:18888	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94010328	MF-950
0226(94/05)	19:18889	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011616	MF-950
0380(94/04)	19:17929	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94010103	MF-950
0520(94/04)	19:17930	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94010884	MF-950
0540(92)	19:18822	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010428	MF-950
0543(93/4Q)	19:17931	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94011459	MF-950

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
0548(92)	19:18319	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94011458	MF-950
0569(94/1Q)	19:18858	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010330	MF-950
0581	19:18827	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE94011160	MF-950
DOE/EIS–					
0150D-Vol.1	19:18818	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010412	MF-630
0150D-Vol.2	19:18819	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010413	MF-630
0150D-Vol.3	19:18820	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010414	MF-630
0150D-Vol.4	19:18821	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010415	MF-630
0166	19:18816	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011182	MF-630
0173	19:18813	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004387	MF-630
0184	19:18347	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004379	MF-602
0198-Rev.2	19:18219	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011044	MF-902
0198-Rev.3	19:18220	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011042	MF-902
DOE/EM–					
0104(1993)-English-Ver.	19:18221	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004217	MF-902
0104(1993)-Spanish-Ver.	19:18017	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009632	MF-902
0144	19:18018	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012129	MF-900
DOE/ER/12085–					
7	19:19676	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010248	MF-408
DOE/ER/13027–					
1-Vol.2	19:18641	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008183	MF-406; MF-706
DOE/ER/13191–					
14	19:20231	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010305	MF-411
DOE/ER/13242–					
10	19:20102	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011209	MF-401
DOE/ER/13296–					
9	19:19127	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011527	MF-401
DOE/ER/13299–					
10	19:19128	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011211	MF-401
DOE/ER/13353–					
T2	19:19677	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011549	MF-408
DOE/ER/13429–					
8	19:20234	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010790	MF-411
DOE/ER/13515–					
9	19:20232	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009651	MF-411
DOE/ER/13621–					
5	19:19678	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011530	MF-408
DOE/ER/13678–					
72	19:18341	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010824	MF-401
73	19:19116	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010825	MF-401
74	19:19117	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010826	MF-401
75	19:19129	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010827	MF-401
76	19:19118	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010828	MF-401
DOE/ER/13768–					
4	19:19130	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010114	MF-401
DOE/ER/13808–					
6	19:19159	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010421	MF-401
DOE/ER/13821–					
T1	19:20533	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011550	MF-411
DOE/ER/13876–					
T1	19:19160	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009769	MF-401
DOE/ER/13909–					
4	19:19679	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011205	MF-408
DOE/ER/13927–					
6	19:19583	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011230	MF-406
DOE/ER/14003–					
5	19:18308	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004374	MF-408
DOE/ER/14004–					
5	19:18309	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010422	MF-408
DOE/ER/14079–					
30	19:20534	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004159	MF-403
DOE/ER/14140–					
T1	19:18963	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011204	MF-406
DOE/ER/14156–					
3	19:19032	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011531	MF-401
DOE/ER/14192–					
3	19:19171	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011224	MF-401

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/14234–2	19:19914	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010740	MF-403
DOE/ER/14258–T1	19:19131	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010224	MF-401
DOE/ER/14261–2	19:17918	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010219	MF-406
DOE/ER/14268–2	19:19033	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010786	MF-404
DOE/ER/14334–T1	19:19132	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011208	MF-401
DOE/ER/20034–1	19:19680	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011590	MF-408
DOE/ER/20070–1	19:19681	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011972	MF-401
DOE/ER/25119–2	19:19275	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008878	MF-406
DOE/ER/30169–T1	19:18624	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010888	MF-406
DOE/ER/40150–262	19:20061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010017	MF-414
264	19:19331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010019	MF-414
DOE/ER/40162–T7	19:20125	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010694	MF-413
DOE/ER/40200–319	19:19979	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009182	MF-414
DOE/ER/40271–T4	19:20126	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008438	MF-414
DOE/ER/40353–20	19:20065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010693	MF-413
DOE/ER/40370–6	19:20115	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010194	MF-413
DOE/ER/40420–T5	19:19948	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008536	MF-413
DOE/ER/40438–1	19:19347	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008902	MF-414
DOE/ER/40616–T1	19:19294	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009848	MF-414
DOE/ER/40646–4	19:20043	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011636	MF-414
DOE/ER/40664–T1	19:19444	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010419	MF-414
DOE/ER/40717–10	19:19949	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009477	MF-414
DOE/ER/40757–015	19:19925	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008529	MF-414
29	19:19926	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008530	MF-414
DOE/ER/45157–T1	19:19288	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010246	MF-404
DOE/ER/45163–40	19:19093	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011207	MF-404
DOE/ER/45291–7	19:19094	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011945	MF-404
8	19:19295	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011532	MF-404
DOE/ER/45365–6	19:19034	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010420	MF-404
DOE/ER/45368–T1	19:19095	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010516	MF-404
DOE/ER/45456–3	19:19068	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011212	MF-404
DOE/ER/53267–129	19:20306	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010832	MF-426
DOE/ER/54081–T1	19:20307	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011588	MF-426
DOE/ER/54241–130	19:20308	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011595	MF-420
DOE/ER/60388–T5	19:19445	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011552	MF-406
DOE/ER/60550–T3	19:18913	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011551	MF-407
DOE/ER/60696–3	19:19697	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004848	MF-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
5	19:19905	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004850	MF-408
DOE/ER/60699–					
3	19:19682	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010196	MF-408
DOE/ER/60789–					
5	19:19698	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004419	MF-408
DOE/ER/60894–					
5	19:19699	OSTI; NTIS; GPO Dep.	E 1.99:	DE94001952	MF-408
DOE/ER/61029–					
16	19:19584	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010010	MF-401; MF-402
DOE/ER/61384–					
2	19:19906	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010217	MF-408
DOE/ER/61417–					
2	19:19683	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010782	MF-408
DOE/ER/61423–					
2	19:19653	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010781	MF-902
DOE/ER/61427–					
1	19:19690	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010250	MF-408
DOE/ER/61549–					
1	19:19530	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004404	MF-402
DOE/ER/61567–					
T1	19:19684	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011401	MF-407
DOE/ER/61604–					
1	19:19907	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010744	MF-401; MF-408
DOE/ER/61606–					
1	19:19694	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004673	MF-408
DOE/ER/61658–					
1	19:19700	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003534	MF-408
DOE/ER/75103–					
T1	19:18642	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010780	MF-400
DOE/ER/75642–					
T1	19:20479	OSTI; NTIS; GPO Dep.	E 1.99:	DE94001157	MF-400
DOE/ET–					
0006T	19:20480	OSTI (Free of Charge)		TI94001295	MF-900
DOE/EW/50625–					
T15	19:19798	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010723	MF-902
DOE/FE–					
0285	19:17933	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004241	MF-126
0294P	19:17885	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010366	PC-101
DOE/FE/61684–					
94/C0264	19:18901	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002958	MF-110
DOE/FTR–					
93017910	19:19318	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93017910	MF-414
94001627	19:19518	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94001627	MF-402
94002466	19:18019	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94002466	MF-814
94002748	19:19531	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94002748	MF-403
94004458	19:17971	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94004458	MF-706
94005837	19:18357	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94005837	MF-270
94006304	19:18020	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006304	MF-814
94006517	19:17766	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006517	MF-108
94006518	19:18415	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006518	MF-261
94007128	19:18829	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007128	MF-220; MF-350
94007636	19:20587	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007636	MF-700
94007908	19:18269	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007908	MF-700
94007909	19:18021	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007909	MF-902
94007912	19:17767	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007912	MF-101
94008240	19:18349	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008240	MF-270
94008241	19:18358	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008241	MF-270
94009140	19:18022	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009140	MF-700
94009397	19:18444	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009397	MF-101
94009628	19:18861	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009628	MF-700
94009739	19:17972	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009739	MF-722
94009794	19:19841	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009794	MF-707
DOE/HWP–					
139	19:18023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010115	MF-902
DOE/ID–					
10253-FY94	19:18024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011024	MF-900
10389	19:18222	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010771	MF-902

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ID/12592–					
6	19:18964	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009346	PC-316
DOE/ID/13074–					
T11	19:19009	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011223	MF-333
DOE/ID/13215–					
T2	19:18025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011114	MF-902
T2-Attach.	19:19915	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011115	MF-902
DOE/IG–					
0004(93)	19:20485	OSTI (Free of Charge)		TI94012228	MF-960
0346	19:20486	OSTI (Free of Charge)		TI94010665	PC-960
0347	19:20487	OSTI (Free of Charge)		TI94012115	PC-960
0348	19:20488	OSTI (Free of Charge)		TI94011625	PC-960
DOE/LLW–					
198	19:18026	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010709	MF-940
DOE/LM–					
0002	19:18862	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005148	MF-900
DOE/MC/10637–					
3710	19:17827	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004103	MF-103
DOE/MC/22118–					
3733	19:17844	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012161	MF-107
DOE/MC/23165–					
94/C0257	19:17886	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002966	MF-111; MF-114
DOE/MC/23174–					
3672	19:17887	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004088	MF-111
94/C0332	19:19001	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009547	MF-111; MF-125
DOE/MC/24116–					
3097	19:17768	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004231	MF-109
3255	19:17769	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004229	MF-109
3267	19:17770	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004230	MF-109
3700	19:17771	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004097	MF-109
DOE/MC/24132–					
3712	19:17889	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004101	MF-103
94/C0335	19:17888	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010108	MF-103
DOE/MC/24193–					
3500	19:19276	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000032	MF-103
3501	19:19277	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000033	MF-103
3503	19:19278	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000035	MF-103
3504	19:19279	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000036	MF-103
DOE/MC/24207–					
3532	19:19585	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000057	PC-107
DOE/MC/25038–					
3457	19:17772	OSTI; INIS; NTIS; GPO Dep.	E 1.99:	DE94000001	MF-109
DOE/MC/25140–					
3555	19:18445	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004232	MF-105
DOE/MC/26006–					
3734	19:18902	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012162	MF-110
DOE/MC/27221–					
94/C0243	19:19002	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002970	MF-106; MF-111
DOE/MC/27226–					
3469	19:17773	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000008	MF-109
DOE/MC/27364–					
94/C0337	19:17890	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010110	MF-103
DOE/MC/28055–					
94/C0334	19:18903	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010383	MF-110
DOE/MC/28060–					
3723	19:18965	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012075	MF-107
DOE/MC/28087–					
3724	19:17936	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012163	MF-132
DOE/MC/28133–					
94/C0336	19:17938	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010111	MF-132
DOE/MC/28138–					
3714	19:17943	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004099	MF-132
DOE/MC/28178–					
3698	19:17939	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004095	MF-132
DOE/MC/29061–					
94/C0269	19:19293	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003191	MF-111
DOE/MC/29103–					
3661	19:18027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004078	PC-902

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/29106–					
3531	19:19916	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94000056	PC-902
DOE/MC/29107–					
3701	19:18966	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004098	PC-902
DOE/MC/29113–					
3689	19:19183	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008633	MF-902
DOE/MC/29119–					
3667	19:19495	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004083	PC-902
DOE/MC/29120–					
3498	19:18028	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94000059	MF-902
DOE/MC/29237–					
94/C0248	19:18904	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002005	MF-110
DOE/MC/29267–					
3458	19:19917	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003504	MF-132
3655	19:17937	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004075	PC-132
DOE/MC/29444–					
3715	19:18423	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004077	MF-109
DOE/METC–					
94/1002	19:17940	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004065	MF-109; MF-123; MF-125; MF-132
94/1003	19:19499	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000085	MF-900
94/1004	19:17861	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000087	MF-103
DOE/METC/C–					
94/7105	19:18446	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002976	MF-111; MF-106
94/7125	19:17891	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011191	MF-103; MF-106
DOE/MWIP–					
14	19:18029	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003997	MF-902; MF-940
15	19:18030	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011598	MF-901
19	19:18031	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011932	MF-901
DOE/NASA–					
50306-4	19:19096	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011222	PC-373
DOE/NV/10630–					
85	19:19532	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011941	MF-721
DOE/NV/10845–					
20	19:19586	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003513	MF-703; MF-702
41	19:18032	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011667	MF-703
DOE/NV/10872–					
T103	19:18033	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011946	MF-814
T105	19:20588	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011948	MF-814
T108	19:18034	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011951	MF-814
T110	19:18184	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011953	MF-814
T72	19:19280	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002503	MF-814
T94	19:19786	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007780	MF-814
DOE/NV/11432–					
1	19:19281	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004304	MF-512
T3	19:18035	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011597	MF-721
DOE/OR–					
01-1175-V3	19:19589	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006285	MF-902
01-1175/V1	19:19587	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006283	MF-902
01-1175/V2	19:19588	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006284	MF-902
DOE/OR/21851–					
T1	19:18845	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008230	PC-600
DOE/OR/22030–					
T2	19:18310	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010690	MF-401
DOE/PC/79796–					
T36	19:18447	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011153	MF-105
DOE/PC/79812–					
T16	19:17774	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005022	PC-108
DOE/PC/79818–					
T9	19:17927	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005032	MF-108
DOE/PC/79916–					
T1	19:17828	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011560	MF-113
DOE/PC/88653–					
T5	19:18899	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011555	MF-112

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/88654–					
T7	19:17745	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010262	MF-102
DOE/PC/88818–					
T4	19:17775	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007958	PC-108
DOE/PC/89653–					
T12	19:18448	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005038	MF-105
DOE/PC/89657–					
T3-Vol.2	19:18449	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011176	MF-105
DOE/PC/89779–					
T8	19:18450	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010724	MF-105
DOE/PC/89868–					
T1	19:17776	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010253	MF-108
DOE/PC/89869–					
T10	19:17778	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005050	MF-108
T11	19:17779	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005051	MF-108
T12	19:17780	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005052	MF-108
T13	19:18332	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010737	MF-108
T9	19:17777	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005049	MF-108
DOE/PC/89883–					
89	19:17781	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010687	PC-108
DOE/PC/90035–					
T7	19:19133	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011562	MF-113
DOE/PC/90042–					
T5	19:18333	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004536	MF-108
DOE/PC/90045–					
T7	19:18334	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004548	MF-109
T9	19:18335	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010727	MF-109
DOE/PC/90046–					
T9	19:19134	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010263	MF-108
DOE/PC/90051–					
T12	19:17782	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005039	MF-102
DOE/PC/90055–					
T12	19:17783	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010738	MF-108
DOE/PC/90096–					
T6	19:17845	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011789	MF-105
DOE/PC/90167–					
T11	19:17862	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011559	MF-102
T12	19:17863	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012006	MF-102
T13	19:17864	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012007	MF-102
T14	19:17865	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012008	MF-102
DOE/PC/90178–					
T8	19:19097	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012189	MF-113
DOE/PC/90180–					
T10	19:20235	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010729	MF-113
DOE/PC/90285–					
T12	19:18451	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011561	MF-113
DOE/PC/90286–					
T7	19:17892	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011134	MF-103
DOE/PC/90287–					
T13	19:17829	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010280	MF-102
DOE/PC/90291–					
T12	19:19135	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003633	MF-113
DOE/PC/90293–					
T12	19:17784	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010279	MF-113
DOE/PC/90294–					
T4	19:17785	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011775	MF-113
DOE/PC/90298–					
T16	19:17786	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011770	MF-113
DOE/PC/90302–					
T8	19:19136	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012055	MF-108
T9	19:17787	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012056	MF-108
DOE/PC/90361–					
T13	19:18452	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010274	MF-105
DOE/PC/90364–					
T7	19:18453	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004547	MF-105
T8	19:18454	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010255	MF-105
DOE/PC/90547–					
T14	19:18455	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011152	MF-105
DOE/PC/90548–					
T12	19:18456	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011145	MF-105

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/91029–					
T13	19:18336	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003738	MF-108
DOE/PC/91029–					
T1	19:17788	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010717	MF-108
DOE/PC/91030–					
T8	19:19137	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010691	MF-132
DOE/PC/91034–					
T7	19:18337	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011124	MF-108
DOE/PC/91039–					
T8	19:17789	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010728	MF-108
DOE/PC/91040–					
32	19:17790	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011116	MF-108
DOE/PC/91042–					
7	19:17791	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010267	MF-108
8	19:17792	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010268	MF-108
DOE/PC/91044–					
T2	19:17793	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011790	MF-108
T3	19:17794	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011791	MF-108
DOE/PC/91047–					
T5	19:17830	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004534	MF-113
DOE/PC/91050–					
T6	19:17795	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010264	MF-108
DOE/PC/91052–					
9	19:17796	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010701	MF-108
DOE/PC/91055–					
T6	19:17797	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010285	MF-108
DOE/PC/91056–					
T4	19:17798	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003306	MF-108
DOE/PC/91057–					
T7	19:17799	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010734	MF-108
DOE/PC/91058–					
T7	19:17800	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002658	MF-108
T9	19:17831	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010699	MF-108
DOE/PC/91154–					
T7	19:18424	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010254	MF-104
DOE/PC/91155–					
T6	19:18425	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011150	MF-112
DOE/PC/91161–					
T7-Rev.1	19:17893	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010278	MF-104
DOE/PC/91281–					
T9	19:17801	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010695	MF-108
DOE/PC/91283–					
T10	19:17746	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011125	MF-102
T11	19:17747	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011126	MF-102
T12	19:17748	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011776	MF-102
DOE/PC/91284–					
9	19:19138	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010742	MF-117
DOE/PC/91285–					
9	19:17832	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011118	MF-113
DOE/PC/91288–					
T11	19:17802	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010273	MF-109
DOE/PC/91290–					
T9	19:17846	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010296	MF-102
DOE/PC/91291–					
T10	19:19139	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010281	MF-108
DOE/PC/91292–					
T10	19:17894	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011147	MF-104
T9	19:17833	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010735	MF-104
DOE/PC/91293–					
8	19:18457	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005025	MF-106
DOE/PC/91299–					
14	19:17834	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011122	MF-102
DOE/PC/91301–					
9	19:17803	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011117	MF-102
DOE/PC/91302–					
8	19:17847	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004545	MF-113
9	19:17848	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010266	MF-113
10	19:17849	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011121	MF-113
DOE/PC/91304–					
T8	19:19140	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010298	MF-108

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/91305–					
9	19:17835	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010743	MF-102
DOE/PC/91309–					
T11	19:19069	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010256	MF-114
DOE/PC/91311–					
T10	19:17805	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011780	MF-113
T8	19:17804	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004524	MF-113
DOE/PC/91343–					
T3	19:18458	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010301	MF-105
T4	19:18459	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010302	MF-105
DOE/PC/91344–					
T7	19:18460	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010277	MF-105
DOE/PC/91346–					
5	19:18461	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010265	MF-105
DOE/PC/92109–					
T4	19:17941	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011784	MF-122
DOE/PC/92110–					
T5	19:18338	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011787	MF-108
DOE/PC/92113–					
T4	19:18339	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011133	MF-113
DOE/PC/92114–					
T2	19:18340	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011130	MF-132
DOE/PC/92116–					
T2	19:19141	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011132	MF-108
DOE/PC/92118–					
T5	19:17806	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010303	MF-108
DOE/PC/92119–					
T3	19:17807	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010299	MF-108
T4	19:17850	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011788	MF-108
DOE/PC/92120–					
T3	19:17808	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011778	MF-108
DOE/PC/92121–					
T5	19:17809	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010297	MF-108
DOE/PC/92147–					
5	19:17810	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010271	MF-108
DOE/PC/92149–					
T5	19:17811	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010698	MF-108
DOE/PC/92176–					
T6	19:17836	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011786	MF-113
DOE/PC/92190–					
T3	19:17749	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010726	MF-105
DOE/PC/92196–					
T3	19:19003	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010283	MF-111
T4	19:19004	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010284	MF-111
DOE/PC/92205–					
T5	19:17750	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011155	MF-102
DOE/PC/92206–					
T3	19:17851	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010258	MF-102
T4	19:17852	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010259	MF-102
DOE/PC/92208–					
T5	19:18426	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010697	MF-102
DOE/PC/92246–					
T3	19:17751	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011129	MF-105
DOE/PC/92251–					
T2	19:17837	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011974	MF-113
T3	19:17838	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011975	MF-113
T4	19:17839	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011976	MF-113
DOE/PC/92521–					
T126	19:17812	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010700	MF-105
DOE/PC/92525–					
T5	19:18301	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010287	MF-109
DOE/PC/92527–					
T5	19:17813	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010733	MF-108
DOE/PC/92530–					
T6	19:17895	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010257	MF-103
DOE/PC/92533–					
5	19:19172	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010741	MF-105
DOE/PC/92536–					
T6	19:17853	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011782	MF-107
DOE/PC/92537–					
T4	19:17814	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011781	MF-108

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/92539–					
6	19:17896	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011120	MF-103
DOE/PC/92543–					
T5	19:17752	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011146	MF-102
DOE/PC/92546–					
T6	19:17753	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011135	MF-102
DOE/PC/92547–					
T3	19:17754	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011151	MF-102
DOE/PC/92578–					
T1	19:17866	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010294	MF-117
T2	19:17867	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010295	MF-117
DOE/PC/93051–					
T1	19:17840	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010291	MF-108
DOE/PC/93202–					
2	19:17841	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011119	MF-113
DOE/PC/93205–					
T1	19:17815	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010292	MF-108
DOE/PC/93209–					
T2	19:17816	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010725	MF-102
DOE/PC/93210–					
1	19:17897	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010722	MF-113
DOE/PC/93212–					
T1	19:18355	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010715	MF-102
T2	19:19533	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011665	MF-102
DOE/PC/93213–					
T2	19:17817	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011148	MF-109
DOE/PC/93214–					
T2	19:18462	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011154	MF-105
DOE/PC/93215–					
T2	19:17818	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011783	MF-102
DOE/PC/93216–					
T2	19:17819	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011127	MF-109
DOE/PC/93217–					
T2	19:17854	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011777	MF-105
DOE/PC/93219–					
T1	19:18905	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010716	MF-110
DOE/PC/93220–					
T2	19:17826	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011149	MF-105
DOE/PC/93221–					
T1	19:17898	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011156	MF-103
DOE/PC/93222–					
1	19:19142	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011157	MF-113
2	19:19143	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011158	MF-113
DOE/PC/93224–					
T1	19:17820	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010714	MF-108
DOE/PC/93225–					
1	19:17899	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010293	MF-114
DOE/RL–					
92-49-Rev.1	19:19842	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011453	MF-900
93-06	19:18036	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010339	MF-902
93-17	19:18957	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010334	MF-905
93-52	19:18037	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011446	MF-900
93-53	19:18958	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011447	MF-905
93-57	19:18038	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011332	MF-900
93-68	19:18185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005486	MF-902
94-0001	19:18039	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011397	MF-721
94-04	19:18846	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010335	MF-902
94-15	19:18223	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010338	MF-902; MF-940
94-32	19:19590	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010337	MF-902
94-37	19:20489	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011443	MF-902
DOE/RW–					
0006-Rev.9	19:17990	OSTI (Free of Charge); INIS		TI94010836	MF-814
0436	19:18043	OSTI (Free of Charge); INIS		TI94009192	MF-812
DOE/RW/00134–					
T5	19:18040	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004175	MF-814
T6	19:19918	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004174	MF-814
T9	19:18041	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010427	MF-814
DOE/RW/00286–					
3	19:18042	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011159	MF-820

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DOE/SF/18852–					
T38	19:18900	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009994	MF-528
DOE/SF/19524–					
2	19:20481	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010249	MF-900
DOE/SR/15199–					
5	19:18627	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002311	MF-700
18	19:18628	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002322	MF-703
DOE/SR/18048–					
T1	19:20482	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011529	MF-500
DOE/SR/18049–					
5	19:19654	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011528	MF-702
DOE/SR/18289–					
2	19:19534	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011213	MF-630
DP–					
1052	19:18282	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006719	MF-713
DPN–					
130	19:18283	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009560	MF-706
131	19:18284	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009561	MF-700
133	19:18285	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009563	MF-700
DPW–					
54-19-4	19:18643	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009954	MF-700
54-688	19:18644	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009953	MF-700
55-104	19:17953	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009951	MF-706
55-108	19:18645	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009950	MF-700
55-154	19:18646	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94010315	MF-704
DTH-LET-RE–					
93-2	19:19005	OSTI; NTIS		DE94763235	
DTH-LV–					
93-22	19:18359	OSTI; NTIS		DE94763260	
93-36	19:18360	OSTI; NTIS		DE94763251	
93-37	19:18361	OSTI; NTIS		DE94763247	
93-38	19:18350	OSTI; NTIS; INIS		DE94763252	
93-39	19:18362	OSTI; NTIS		DE94763253	
93-40	19:18363	OSTI; NTIS		DE94763248	
93-41	19:18364	OSTI; NTIS		DE94763249	
93-42	19:18365	OSTI; NTIS		DE94763250	
93-43	19:18366	OSTI; NTIS		DE94763246	
93-44	19:18367	OSTI; NTIS		DE94763242	
93-45	19:18368	OSTI; NTIS		DE94763243	
93-46	19:18369	OSTI; NTIS		DE94763244	
93-47	19:18370	OSTI; NTIS		DE94763245	
DUN–					
4927	19:18772	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007827	MF-520
5300-RD	19:18773	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007850	MF-700
5302-RD	19:18774	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007851	MF-700
5303-RD	19:18775	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007935	MF-700
EDR–					
16194	19:19008	*See* DOE/CH/10435–T15			
EGG–					
10617-1192	19:19535	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004688	MF-702
11265-2030	19:19591	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006475	MF-702
11265-2031	19:18044	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006482	MF-702
2701	19:18091	*See* NUREG/CR–6070			
2721	19:18516	*See* NUREG/CR–6160			
2723	19:20432	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010996	PC-425
2733	19:18517	*See* NUREG/CR–6196			
EGG-APO–					
10944	19:19487	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010772	MF-406
EGG-CMRE–					
11006	19:19592	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010773	MF-901; MF-906
EGG-ENV–					
10975	19:18045	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010796	MF-902
EGG-EP–					
10557	19:18397	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010769	MF-252
9371	19:18824	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010704	MF-331
EGG-FSP–					
10960	19:20229	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010775	MF-410
11109	19:20433	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010708	MF-420
EGG-LLW–					
11140	19:18046	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010778	MF-940

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EGG-MS–					
10992	19:19446	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010702	MF-406
EGG-NRP–					
10991	19:18047	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010797	MF-902
11015	19:18647	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94010712	MF-1020
EGG-RTAP–					
10925	19:18776	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010774	
EGG-WM–					
10701	19:18048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010770	MF-902
10823-Rev.1	19:19593	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008521	MF-940
10974	19:18049	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008524	MF-902
11066	19:19594	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010795	MF-902
11179	19:18050	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010765	MF-902
11205	19:19595	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010764	MF-940
EGG-WMO–					
10279-Vol.1	19:18186	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008522	MF-900
10279-Vol.2	19:19596	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008523	MF-900
EGG-WTD–					
10719	19:18051	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008516	MF-940
10931	19:18052	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010777	MF-940
10935	19:18053	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008512	MF-900
10988	19:18054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010776	MF-906
10993	19:18224	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010703	MF-901
EP–					
298	19:20483	OSTI (Free of Charge)		TI94010417	MF-900
ES/ER/TM–					
102	19:18226	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006323	MF-902
75	19:19597	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006375	MF-902
84/V1	19:19587	*See* DOE/OR–01-1175/V1			
84/V2	19:19588	*See* DOE/OR–01-1175/V2			
84/V3	19:19589	*See* DOE/OR–01-1175-V3			
85	19:19598	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009875	MF-902
86	19:18225	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006321	MF-902
95	19:19599	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006324	MF-902
ESD–					
4138	19:18234	*See* ORNL/TM–12401			
ESTSC–					
000138SUN0001	19:20535	ESTSC			
000142IBMPC02	19:20536	ESTSC			
000324SUN0003	19:20537	ESTSC; Lawrence Livermore National Lab			
000533IBMPC00	19:20538	ESTSC			
000556AP00000	19:20539	ESTSC			
000585PSC1200	19:20540	ESTSC			
000607SPARC00	19:20541	ESTSC; 09/08/93 SSC to convert from cartridge			
000607SPARC01	19:20542	ESTSC			
000609I303300	19:20543	ESTSC			
000614SPARC00	19:20544	ESTSC			
000614SPARC01	19:20545	ESTSC			
000644SGIIP00	19:20546	ESTSC			
000644SPARC00	19:20547	ESTSC			
000649IBMPC01	19:20548	ESTSC			
000672IBMPC01	19:20549	ESTSC			
000673SUN0000	19:20550	ESTSC			
000679IBMPC00	19:20551	ESTSC			
000683D0VAX00	19:20552	ESTSC			
000683D500000	19:20553	ESTSC			
000684D0VAX00	19:20554	ESTSC			
000684D500000	19:20555	ESTSC			
000685D0VAX00	19:20556	ESTSC			
000686D500000	19:20557	ESTSC			
000690D0VAX00	19:20558	ESTSC			
000714C760000	19:20559	ESTSC			
ETDE/JP-mf–					
9468086	19:18380	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768086	
94768067	19:18374	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768067	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
FEMP/SUB–					
070	19:18055	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008558	MF-721
FINNRA-REP–					
15/1992	19:18989	OSTI; NTIS		DE94763317	
FNAL-TM–					
1879	19:19415	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010331	MF-414
1880	19:19332	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010332	MF-414
1882	19:19348	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011746	MF-414
1883	19:19447	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011747	MF-414
FNAL/C–					
93/337-E	19:20044	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011750	MF-414
94/044-E	19:20062	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010333	MF-414
94/084	19:19934	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011749	MF-412
FRCR–					
444	19:20306	*See* DOE/ER/53267–129			
445	19:20308	*See* DOE/ER/54241–130			
FUB-HEP–					
93-14	19:19999	*See* DESY–93-195			
93-20	19:19995	*See* DESY–93-178			
FVU-FU–					
93-11	19:18990	OSTI; NTIS		DE94763355	
93-15	19:18914	OSTI; NTIS		DE94763356	
FZR–					
93-08	19:19448	OSTI; NTIS (US Sales Only); INIS		DE94766193	
93-22(prepr.)	19:20133	OSTI; NTIS (US Sales Only); INIS		DE94769141	
93-28(prepr.)	19:20003	OSTI; NTIS (US Sales Only); INIS		DE94769246	
93-29(prepr.)	19:20004	OSTI; NTIS (US Sales Only); INIS		DE94769247	
GANIL-A–					
93-02	19:19349	OSTI; NTIS (US Sales Only); INIS		DE94623620	
93-03	19:19350	OSTI; NTIS (US Sales Only); INIS		DE94622499	
93-04	19:19333	OSTI; NTIS (US Sales Only); INIS		DE94622489	
93-05	19:19351	OSTI; NTIS (US Sales Only); INIS		DE94622504	
93-06	19:19319	OSTI; NTIS (US Sales Only); INIS		DE94622485	
GANIL-P–					
93-18	19:20068	OSTI; NTIS (US Sales Only); INIS		DE94623917	
93-22	19:20116	OSTI; NTIS (US Sales Only); INIS		DE94622910	
GCW–					
0593	19:20560	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011594	MF-405
GRS–					
96	19:20589	OSTI; NTIS (US Sales Only); INIS		DE94769708	
GSF–					
17/92	19:19843	OSTI; NTIS (US Sales Only); INIS		DE94769721	
3/94	19:19536	OSTI; NTIS (US Sales Only); INIS		DE94769086	
GSI–					
93-45	19:20309	OSTI; NTIS (US Sales Only); INIS		DE94769133	
93-75(prepr.)	19:20134	OSTI; NTIS (US Sales Only); INIS		DE94766363	
93-83(prepr.)	19:20135	OSTI; NTIS (US Sales Only); INIS		DE94769135	
94-01(prepr.)	19:20136	OSTI; NTIS (US Sales Only); INIS		DE94769136	
94-02(prepr.)	19:20137	OSTI; NTIS (US Sales Only); INIS		DE94769249	
94-03(prepr.)	19:20138	OSTI; NTIS (US Sales Only); INIS		DE94768879	
94-04(prepr.)	19:20139	OSTI; NTIS (US Sales Only); INIS		DE94768878	
94-11(prepr.)	19:20222	OSTI; NTIS (US Sales Only); INIS		DE94769094	
94-12(prepr.)	19:20140	OSTI; NTIS (US Sales Only); INIS		DE94768980	
94-13(prepr.)	19:19980	OSTI; NTIS (US Sales Only); INIS		DE94768977	
94-14(prepr.)	19:20141	OSTI; NTIS (US Sales Only); INIS		DE94768976	
94-15(prepr.)	19:20142	OSTI; NTIS (US Sales Only); INIS		DE94768978	
94-16(prepr.)	19:20069	OSTI; NTIS (US Sales Only); INIS		DE94768979	
GTFR–					
112	19:20310	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010202	MF-420
HAN–					
43413	19:18629	*See* HW–23648			
91479	19:18057	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007880	MF-700
96780	19:19655	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007882	MF-602
HD-THEP–					
93-22	19:20023	*See* DESY–93-163			
93-27	19:19986	*See* NIKHEF-H–93-16			
93-41	19:20002	*See* DESY–94-017			
HDC–					
969	19:17954	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009743	MF-702
HEP-LAT–					
9311037	19:19974	*See* DESY–93-164			

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9311040	19:19974	*See* DESY–93-164			
9312039	19:19976	*See* DESY–93-184			
9312079	19:19994	*See* DESY–93-165			
HEP-PH–					
9310348	19:20020	*See* DESY–93-099			
9401290	19:20000	*See* DESY–94-006			
9401291	19:20036	*See* DESY–94-008			
9402227	19:20032	*See* DESY–93-192			
HEP-TH–					
9301297	19:19950	*See* BONN-HE–93-43			
9306162	19:19985	*See* NIKHEF-H–93-15			
9307107	19:19986	*See* NIKHEF-H–93-16			
9312049	19:19951	*See* BONN-HE–93-49			
9312150	19:19977	*See* DESY–93-191			
9312182	19:19952	*See* BONN-HE–93-52			
9402110	19:19924	*See* DESY–94-019			
HLRZ–					
93-51	19:19999	*See* DESY–93-195			
93-74	19:19995	*See* DESY–93-178			
HPO–					
73-001	19:19565	*See* RFP–4849			
HU-BERLIN-IEP–					
93/6	19:19996	*See* DESY–93-180			
HW–					
12730	19:17955	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007746	MF-520
12795-Del.	19:17956	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009185	MF-711
22601	19:17957	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009742	MF-702
23151-Del.	19:17958	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007885	MF-700
23648	19:18629	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006081	MF-702
25396	19:17959	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006967	MF-711
27283	19:17960	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007748	MF-711
27428	19:18649	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006694	MF-520
3-1241	19:19849	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006160	MF-507
3-3366	19:18648	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009777	MF-700
30613	19:17961	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007749	MF-711
32609	19:19600	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009492	MF-702
34311	19:18782	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006961	MF-707
34487	19:18058	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006697	MF-510
35496	19:17966	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006695	MF-711
38052	19:18059	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007325	MF-510
38573	19:18630	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009746	MF-502
48741	19:17948	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009493	MF-600
55161	19:18650	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006979	MF-520
56269	19:18651	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010933	MF-520
56350-RD	19:18783	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010908	MF-500
56525-F	19:18652	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010941	MF-500
56569	19:18653	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010986	MF-500
56589	19:18654	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010590	MF-500
56644	19:18655	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010587	MF-500
56704-C	19:18656	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010624	MF-500
56817-RD	19:18657	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010604	MF-520
57007-RD	19:18658	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010598	MF-500
57109	19:18659	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010606	MF-520
57353	19:18660	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010903	MF-500
57387	19:18661	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010616	MF-500
57556	19:18662	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010880	MF-506
58606	19:18784	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011069	MF-520
60164	19:18785	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010875	MF-520
60333-Pt.2	19:18286	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011314	MF-500
60333-Pt.3	19:18287	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011313	MF-500
63122-A	19:18663	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010988	MF-500
64632	19:18664	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011100	MF-520
64859-RD	19:18665	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010962	MF-500
65053	19:18666	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010566	MF-500
65563	19:18667	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010478	MF-520
65579	19:18668	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011303	MF-500
65605	19:18669	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010971	MF-520
65649	19:18670	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010970	MF-520
65715	19:18671	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010969	MF-520
65717	19:18672	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010631	MF-500
65753	19:18673	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010949	MF-500

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
65789	19:18674	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010491	MF-500
65863	19:18675	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011082	MF-500
65867	19:18676	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011307	MF-500
65870-C	19:18677	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011273	MF-500
66015	19:19119	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009744	MF-502
66089	19:18678	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011271	MF-500
66123	19:18679	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011270	MF-520
66130	19:18680	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011269	MF-500
66147	19:18060	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009745	MF-702
66839	19:18681	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011094	MF-500
66883-Vol.1	19:18786	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011093	MF-500
66973	19:18682	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011109	MF-500
67946	19:18683	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011105	MF-500
68337-App.-Del.	19:18684	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007808	MF-602
68448-A	19:18685	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010955	MF-500
68550	19:18787	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010502	MF-500
68855	19:18686	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010783	MF-500
69314	19:18687	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011079	MF-500
69321	19:18688	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010983	MF-520
69422	19:18689	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010934	MF-520
69499	19:18690	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010476	MF-520
69985	19:18691	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007888	MF-603
70520	19:18788	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010922	MF-500
70630	19:18789	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010923	MF-500
71062	19:18692	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010514	MF-500
71134	19:18693	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010622	MF-500
72507-RD	19:18694	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010554	MF-500
72541-A	19:18695	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010553	MF-500
72541-C	19:18696	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010552	MF-500
73064	19:18697	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011276	MF-500
73209	19:18698	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011281	MF-500
73615-SUP.3	19:18699	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010555	MF-500
73707-App.1-Del.	19:18700	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007637	MF-602
73763	19:18790	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011305	MF-500
74122	19:18701	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010964	MF-520
75414	19:18702	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010650	MF-500
75452	19:19538	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008769	MF-603
75456	19:18703	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010918	MF-500
75607-A	19:18704	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010560	MF-500
75962	19:18705	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010849	MF-500
76259	19:18706	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010641	MF-520
76327-RD	19:18707	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007815	MF-700
76361	19:18270	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010642	MF-500
76368	19:18708	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010917	MF-500
76421	19:18709	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010549	MF-500
76501	19:18710	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011317	MF-500
76847	19:17962	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010912	MF-500
76910	19:18711	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011084	MF-500
76996-B	19:18712	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010511	MF-500
77040-RD	19:18713	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011074	MF-500
77212	19:18714	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011285	MF-500
77230	19:18715	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011286	MF-500
77338	19:19184	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011275	MF-500
77378	19:18716	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011288	MF-500
77579	19:18717	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011291	MF-500
77579-B	19:18718	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011292	MF-500
77872	19:18719	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011261	MF-520
77875	19:18720	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011306	MF-500
77929	19:18721	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011263	MF-500
78095	19:18722	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011264	MF-520
78170	19:18723	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011265	MF-520
78366	19:18791	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010611	MF-500
78375-RD	19:18724	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010480	MF-500
78596	19:18725	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011086	MF-500
78960	19:18726	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010483	MF-520
79209	19:18727	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010593	MF-500
79465	19:18728	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010531	MF-500
79718	19:18288	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011280	MF-500
80676	19:18792	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010557	MF-500
80677	19:18793	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010628	MF-500
80729	19:18729	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010558	MF-500

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80817	19:18730	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010647	MF-500
80888	19:18631	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007809	MF-603
80908	19:18731	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010546	MF-500
81015	19:18732	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010548	MF-500
81026	19:18733	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011297	MF-520
81028	19:18734	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011296	MF-520
81041	19:18735	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011295	MF-520
81050	19:18271	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011260	MF-500
81170-RD	19:18794	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010913	MF-500
81579-RD	19:18736	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011278	MF-500
81747-RD-Rev.1	19:18737	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010595	MF-500
82744	19:18738	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010551	MF-500
82744-SUPP.1	19:18739	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010484	MF-500
82977-RD-2	19:18740	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010978	MF-520
82977-RD-3-Rev.	19:18741	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010977	MF-520
83236	19:18742	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010645	MF-500
83834	19:18743	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010914	MF-500
83906-A-RD	19:18061	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007900	MF-502
83906-B-RD	19:18062	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007901	MF-510
84080-RD	19:18744	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010856	MF-500
84415	19:18632	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007090	MF-510
9476	19:19537	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012052	MF-502
IAE–					
0114.	19:19437	*See* CNIC–00682			
0115.	19:20511	*See* CNIC–00700			
IAEA-SM–					
333/102	19:18264	*See* BNL–49975			
333/117	19:18265	*See* BNL–49979			
333/164	19:18266	*See* BNL–60131			
IAEA-TECDOC–					
732	19:18063	OSTI; NTIS (US Sales Only); INIS		DE94623709	
734	19:19701	OSTI; NTIS (US Sales Only); INIS		DE94623461	
737	19:18795	OSTI; NTIS (US Sales Only); INIS		DE94624677	
741	19:18541	OSTI; NTIS (US Sales Only); INIS		DE94624700	
IKP-TUW–					
9311401	19:19975	*See* DESY–93-177			
IN-MSU–					
93-30/322	19:20038	*See* DESY–94-010			
INCT–					
2136/5	19:19144	OSTI; NTIS (US Sales Only); INIS		DE94623304	
INDC(NDS)–					
286/L	19:20143	OSTI; NTIS (US Sales Only); INIS		DE94624968	
288/L	19:20158	OSTI; NTIS (US Sales Only); INIS		DE94624975	
INIS-BR–					
3306	19:19035	OSTI; NTIS (US Sales Only); INIS		DE94624152	
3307	19:19036	OSTI; NTIS (US Sales Only); INIS		DE94624146	
3308	19:19070	OSTI; NTIS (US Sales Only); INIS		DE94624187	
3309	19:19071	OSTI; NTIS (US Sales Only); INIS		DE94624188	
3310	19:19037	OSTI; NTIS (US Sales Only); INIS		DE94624153	
3311	19:19072	OSTI; NTIS (US Sales Only); INIS		DE94624189	
INIS-JP–					
019	19:19539	OSTI; NTIS; INIS		DE94765351	
020	19:18745	OSTI; NTIS; INIS		DE94765352	
INIS-RU–					
364	19:20413	OSTI; NTIS (US Sales Only); INIS			
375	19:19322	OSTI; NTIS (US Sales Only); INIS		DE94623502	
INIS-UA–					
003	19:19752	OSTI; NTIS (US Sales Only); INIS		DE94624344	
INIS-XN–					
497	19:18278	OSTI; NTIS (US Sales Only); INIS		DE94623830	
498	19:18279	OSTI; NTIS (US Sales Only); INIS		DE94623831	
INIS-mf–					
13804	19:18513	OSTI; NTIS (US Sales Only); INIS		DE94622182	
13805	19:18586	OSTI; NTIS (US Sales Only); INIS		DE94622529	
13809(v.1,2)	19:20312	OSTI; NTIS (US Sales Only); INIS		DE94622995	
13817	19:18478	OSTI; NTIS (US Sales Only); INIS		DE94622537	
13846	19:18526	OSTI; NTIS (US Sales Only); INIS		DE94622203	
13847	19:18527	OSTI; NTIS (US Sales Only); INIS		DE94622014	
13849	19:20490	OSTI; NTIS (US Sales Only); INIS		DE94622204	
13853	19:20301	OSTI; NTIS (US Sales Only); INIS		DE94622051	
13854	19:19724	OSTI; NTIS (US Sales Only); INIS		DE94622019	

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13855	19:18479	OSTI; NTIS (US Sales Only); INIS		DE94622538	
13857	19:20447	OSTI; NTIS (US Sales Only); INIS		DE94625065	
13858	19:20448	OSTI; NTIS (US Sales Only); INIS		DE94625066	
13859	19:20449	OSTI; NTIS (US Sales Only); INIS		DE94625067	
13860	19:20450	OSTI; NTIS (US Sales Only); INIS		DE94625068	
13861	19:20451	OSTI; NTIS (US Sales Only); INIS		DE94625069	
13865	19:18878	OSTI; NTIS (US Sales Only); INIS		DE94623737	
13866	19:18514	OSTI; NTIS (US Sales Only); INIS		DE94623663	
13869	19:20493	OSTI; NTIS (US Sales Only); INIS		DE94624814	
13870	19:20494	OSTI; NTIS (US Sales Only); INIS		DE94624077	
13872	19:20496	OSTI; NTIS (US Sales Only); INIS		DE94624078	
14203	19:18847	OSTI; NTIS (US Sales Only); INIS; Also published in Bundestag-Drucksache 12/3846 of November 11, 1992		DE94766626	
14204	19:18848	OSTI; NTIS (US Sales Only); INIS		DE94766627	
14208	19:19416	OSTI; NTIS (US Sales Only); INIS		DE94768877	
14211	19:20296	OSTI; NTIS (US Sales Only); INIS		DE94769715	
14212	19:19541	OSTI; NTIS (US Sales Only); INIS		DE94769355	
INS–					
1009	19:19353	OSTI; NTIS; INIS		DE94765445	
1010	19:19323	OSTI; NTIS; INIS		DE94765444	
978	19:19334	OSTI; NTIS; INIS		DE94765443	
980	19:19352	OSTI; NTIS; INIS		DE94765442	
981	19:19335	OSTI; NTIS; INIS		DE94765448	
INS-T–					
515	19:19417	OSTI; NTIS; INIS		DE94765549	
521	19:19354	OSTI; NTIS; INIS		DE94765556	
523	19:19418	OSTI; NTIS; INIS		DE94765587	
IS–					
5106	19:18227	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011203	MF-402; MF-406
IS-T–					
1678	19:19041	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011200	MF-401
1680	19:19100	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011201	MF-401
ITP-Budapest–					
505	19:20000	*See* DESY–94-006			
ITP-SB–					
93-84	19:19951	*See* BONN-HE–93-49			
ITP-UH–					
24/93	19:19977	*See* DESY–93-191			
JAERI-M–					
93-219	19:20452	OSTI; NTIS; INIS		DE94765449	
93-245	19:20453	OSTI; NTIS; INIS		DE94765547	
JINR-E–					
7-93-126	19:20159	OSTI; NTIS (US Sales Only); INIS		DE94623321	
Juel–					
2764	19:19542	OSTI; NTIS (US Sales Only); INIS		DE94769717	
2825	19:19465	OSTI; NTIS (US Sales Only); INIS		DE94769098	
2840	19:20047	OSTI; NTIS (US Sales Only); INIS		DE94768981	
2844	19:20048	OSTI; NTIS (US Sales Only); INIS		DE94769010	
2846	19:20212	OSTI; NTIS (US Sales Only); INIS		DE94768750	
2857	19:20091	OSTI; NTIS (US Sales Only); INIS		DE94768751	
2858	19:19165	OSTI; NTIS (US Sales Only); INIS		DE94768659	
KCP–					
613-5271	19:19296	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010212	MF-706
613-5291	19:19229	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010213	MF-705
613-5292	19:19297	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010885	MF-706
KEK–					
93-9	19:19336	OSTI; NTIS; INIS		DE94765446	
93-179	19:20038	*See* DESY–94-010			
KEK-CP–					
012	19:20038	*See* DESY–94-010			
KEK-PROC–					
92-18	19:20092	OSTI; NTIS; INIS		DE94765589	
KFK–					
5222	19:18915	OSTI; NTIS (US Sales Only)		DE94768975	
5235	19:20454	OSTI; NTIS (US Sales Only); INIS		DE94769314	
5244	19:20562	OSTI; NTIS (US Sales Only)		DE94769312	
5255	19:18553	OSTI; NTIS (US Sales Only); INIS		DE94769097	
5256	19:19073	OSTI; NTIS (US Sales Only); INIS		DE94768973	
5257	19:19124	OSTI; NTIS (US Sales Only)		DE94769328	

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5270	19:18991	OSTI; NTIS (US Sales Only)		DE94765959	
KFK-PEF–					
112	19:19543	OSTI; NTIS (US Sales Only); INIS		DE94766043	
116	19:18463	OSTI; NTIS (US Sales Only)		DE94769144	
KFTI–					
93-02-REV	19:19044	OSTI; NTIS (US Sales Only); INIS		DE94624184	
93-9	19:20414	OSTI; NTIS (US Sales Only); INIS		DE94625050	
93-33	19:20213	OSTI; NTIS (US Sales Only); INIS		DE94624976	
93-34	19:20415	OSTI; NTIS (US Sales Only); INIS		DE94625049	
93-35	19:19101	OSTI; NTIS (US Sales Only); INIS		DE94624236	
93-37	19:20563	OSTI; NTIS (US Sales Only); INIS		DE94624807	
KTM/E-B–					
171	19:19544	OSTI; NTIS; INIS		DE94763290	
KTM/E-D–					
200	19:18916	OSTI; NTIS		DE94763289	
201	19:18280	OSTI; NTIS; INIS		DE94624797	
KVI–					
1002(prepr.)	19:20094	OSTI; NTIS		DE94769255	
1003(prepr.)	19:20095	OSTI; NTIS		DE94769254	
989(prepr.)	19:20093	OSTI; NTIS		DE94769253	
LA–					
11652-MS-Rev.1	19:18228	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004190	MF-702
12654	19:18081	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001570	PC-940
12704	19:20224	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010682	MF-705
12739-PR	19:19880	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010051	MF-707
12763-SR	19:18187	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011021	MF-507
12766-MS	19:19019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010215	MF-700
12769-MS	19:19470	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94010519	MF-700
12777-MS	19:19325	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011609	
LA-SUB–					
93-187	19:20096	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94012082	MF-413
93-306	19:18229	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005656	MF-940; MF-902
93-309	19:18413	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009938	MF-251
94-54	19:18863	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009068	
LA-UR–					
93-3063	19:19787	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005599	
93-3546	19:20604	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002628	MF-900
93-3581	19:19230	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94003978	
93-3691	19:18082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94002699	MF-814
93-3699	19:19919	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002698	MF-703
93-4072	19:19173	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003945	MF-742; MF-703
93-4253	19:18083	OSTI; INIS; NTIS; GPO Dep.	E 1.99:	DE94004989	MF-802; MF-402
94-1087	19:18084	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009327	MF-940
94-1118	19:19937	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009322	
94-1175	19:20050	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011650	MF-414
94-1178	19:20214	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011651	MF-413
94-1197	19:19299	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011654	MF-414
94-1205	19:19011	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011653	
94-1206	19:19283	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011657	
94-1238	19:19290	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011711	MF-705
94-1264	19:20215	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011712	MF-413
94-1271	19:20097	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011713	MF-413
94-1284	19:18582	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011717	MF-413
94-1300	19:20051	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011720	MF-414
94-1316	19:19074	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011723	MF-404
94-1351	19:18085	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011692	MF-414
94-1377	19:20216	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011695	MF-413
94-1378	19:19938	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011694	MF-700
94-1379	19:19939	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011693	MF-700
94-1395	19:18273	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011698	MF-900
94-1417	19:19075	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011696	MF-364
94-1440	19:20098	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011700	MF-413
94-1455	19:19940	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011702	MF-412
94-1471	19:20217	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011709	MF-413
94-400	19:19605	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007526	MF-940
94-418	19:19920	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006164	MF-403
94-419	19:19282	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008101	MF-403
94-491	19:19147	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007533	MF-372

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
LA-UR–					
94-705	19:18849	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007554	MF-900; MF-902
94-802	19:19298	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009303	MF-706
94-846	19:18230	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009310	MF-902
94-887	19:18272	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009314	MF-700
94-988	19:19020	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009340	MF-906
LBL–					
32657	19:19300	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011360	MF-404
34182	19:19125	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011357	MF-404
34446	19:19486	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011342	MF-404
34610	19:19982	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011908	MF-414
34750	19:19397	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011371	MF-406
34751	19:19428	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011370	MF-406
34831	19:20006	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011347	MF-413
34865	19:19606	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011376	MF-405
34924	19:20233	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011380	MF-411
34928	19:20099	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011343	MF-413
34942	19:19929	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011358	MF-414
34945	19:18917	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE94011216	MF-350
34946	19:18918	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE94011217	MF-350
34947	19:18919	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE94011218	MF-350
34966	19:19398	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011366	MF-408
34997	19:19102	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011622	MF-404
35126	19:19148	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011910	MF-401
35128	19:20007	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011377	MF-414
35143	19:19316	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011363	MF-414
35194	19:19149	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011373	MF-401
35224	19:19545	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011372	MF-800
35229	19:20218	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011379	MF-413
35232	19:19338	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011382	MF-414
35236	19:20219	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011354	MF-413
35277	19:19941	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011367	MF-413
35281	19:19779	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011378	MF-405
35295	19:20008	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011344	MF-414
35305	19:19488	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011300	MF-410
35316	19:20052	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011368	MF-413
35318	19:19174	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011346	MF-400
35323	19:19399	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011349	MF-414
35330	19:20220	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011341	MF-414
35335	19:20455	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011009	MF-419
35354	19:19150	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011907	MF-401
35374	19:17821	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011014	MF-109
35376	19:18992	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011015	MF-350
35381	19:18086	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011016	MF-814
35387	19:18087	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011017	MF-814
35402	19:18920	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011906	MF-350
35431	19:19151	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011012	MF-401
35432	19:19152	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011011	MF-401
35438	19:19942	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011903	MF-413
35448	19:19685	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011800	
35454	19:18088	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011013	MF-811
35488	19:19686	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011912	MF-408
35489	19:19687	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011915	MF-408
35491	19:20236	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011913	MF-404
35495	19:19881	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011914	MF-405
LBL-PUB–					
5380	19:19471	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011361	MF-413; MF-414
743	19:18850	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011901	MF-408
LCHS-A–					
3-R-1	19:18316	OSTI; NTIS; INIS; Also available from: Lund Centre for Habitat Studies, Box 118, S-22100 Lund, Sweden		DE94763354	
LIU-TEK-LIC–					
1993-55	19:19780	OSTI; NTIS; INIS		DE94624425	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
LU-TP–					
93-27	19:20009	OSTI; NTIS; INIS		DE94624906	
LUTADL-TAA–					
3-1003	19:18921	OSTI; NTIS		DE94763353	
MISU-IMI-CM–					
81	19:19546	OSTI; NTIS		DE94763351	
83	19:19547	OSTI; NTIS		DE94763347	
MISU-IMI-DM–					
64	19:19548	OSTI; NTIS		DE94763350	
MPI-PhE–					
94-03	19:19472	OSTI; NTIS (US Sales Only); INIS		DE94768767	
MSHA/IR–					
1206	19:17859	OSTI; NTIS		DE94011053	
1214	19:17904	OSTI; NTIS		DE94011054	
1215	19:17905	OSTI; NTIS		DE94011055	
1216	19:19911	OSTI; NTIS		DE94011056	
NAI-SR–					
139	19:18638	*See* WSRC-TR–93-543			
NASA-TM–					
106472	19:19096	*See* DOE/NASA–50306-4			
NCEC–					
0001.	19:18007	*See* CNIC–00731			
NEA/CSNI/R–					
(93)8	19:18798	*See* NUREG/CP–0127			
94-3	19:18516	*See* NUREG/CR–6160			
NEDO-NP–					
9201	19:18906	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768105	
9202	19:18907	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768106	
9203	19:18908	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768107	
9204	19:18814	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE94768108	
NEI-DK–					
1460	19:18281	OSTI; NTIS; INIS		DE94624798	
1466	19:18897	OSTI; NTIS		DE94763241	
1478	19:18371	OSTI; NTIS		DE94763256	
1485	19:18372	OSTI; NTIS		DE94763284	
1486	19:18373	OSTI; NTIS		DE94763285	
1487	19:18993	OSTI; NTIS		DE94763286	
1492	19:18967	OSTI; NTIS		DE94763273	
1493	19:18968	OSTI; NTIS		DE94763274	
1494	19:18969	OSTI; NTIS		DE94763275	
1495	19:18970	OSTI; NTIS		DE94763276	
1496	19:18971	OSTI; NTIS		DE94763277	
1497	19:18972	OSTI; NTIS		DE94763278	
1498	19:18922	OSTI; NTIS		DE94763279	
1499	19:18973	OSTI; NTIS		DE94763280	
1500	19:18974	OSTI; NTIS		DE94763281	
1501	19:18975	OSTI; NTIS		DE94763282	
1511	19:18311	OSTI; NTIS		DE94763283	
1778-Ed.2	19:18825	OSTI; NTIS		DE94763236	
1779	19:18417	OSTI; NTIS		DE94763240	
NEI-FI–					
217	19:19045	OSTI; NTIS		DE94763309	
224	19:18089	OSTI; NTIS; INIS		DE94624769	
225	19:18994	OSTI; NTIS		DE94002067	
NEI-NO–					
399	19:19607	OSTI; NTIS		DE94763338	
400	19:18830	OSTI; NTIS; INIS		DE94763339	
NERDI–					
0002.	19:20508	*See* CNIC–00119			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
0003.	19:20509	*See* CNIC–00120			
NESC–					
775	19:20559	*See* ESTSC–000714C760000			
NEA0329	19:20538	*See* ESTSC–000533IBMPC00			
NIFS–					
248	19:20416	OSTI; NTIS; INIS		DE94765548	
NIKHEF-H–					
93-05	19:19983	OSTI; NTIS		DE94769256	
93-09	19:20010	OSTI; NTIS		DE94769261	
93-11	19:19473	OSTI; NTIS		DE94769258	
93-13	19:19984	OSTI; NTIS		DE94769257	
93-15	19:19985	OSTI; NTIS		DE94769259	
93-16	19:19986	OSTI; NTIS		DE94769260	
NIPER–					
689(Vol.1)	19:18427	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000125	PC-122
689(Vol.2)	19:18428	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000126	PC-122
691	19:17919	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000103	PC-122
705	19:17922	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000104	PC-122
710	19:17923	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000105	PC-122
712	19:17924	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000107	PC-122
713	19:17907	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000106	PC-122
720	19:17925	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000108	PC-122
722	19:17926	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000109	PC-122
NIRS-M–					
88(v.1)	19:19886	OSTI; NTIS; INIS		DE94765353	
88(v.2)	19:19887	OSTI; NTIS; INIS		DE94765354	
88(v.3)	19:19888	OSTI; NTIS; INIS		DE94765355	
88(v.4)	19:19889	OSTI; NTIS; INIS		DE94765356	
88(v.5)	19:19890	OSTI; NTIS; INIS		DE94765357	
88(v.6)	19:19891	OSTI; NTIS; INIS		DE94765358	
88(v.7)	19:19892	OSTI; NTIS; INIS		DE94765359	
NIRS-R–					
23	19:19893	OSTI; NTIS; INIS		DE94765349	
NIST-SP–					
500-216	19:18799	*See* NUREG/CP–0136			
NREL/SP–					
280-5794	19:18864	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006857	MF-233
420-5877	19:18302	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000217	MF-233
NREL/TP–					
411-6470	19:18356	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006895	MF-270
425-6357	19:19014	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000214	MF-335
430-6080	19:18320	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006905	MF-247
432-5028	19:19012	OSTI; NTIS; GPO Dep.	E 1.99:	DE94000213	MF-315
451-6400	19:19103	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006918	MF-270
NUREG–					
0040-Vol.18-No.1	19:18565	OSTI; NTIS; INIS; GPO		TI94012164	
0540-Vol.16-No.3	19:18566	OSTI; NTIS; INIS; GPO		TI94012159	
0750-Vol.38-Index-1	19:18567	OSTI; NTIS; GPO; INIS		TI94007718	
0750-Vol.38-Index-2	19:18568	OSTI; NTIS; INIS; GPO		TI94010208	
0750-Vol.38-No.6	19:18569	OSTI; NTIS; INIS; GPO		TI94007836	
0750-Vol.39-No.1	19:18570	OSTI; NTIS; INIS; GPO		TI94010209	
0750-Vol.39-No.2	19:18571	OSTI; NTIS; GPO; INIS		TI94010210	
0847-Suppl.-No.13	19:18797	OSTI; NTIS; INIS; GPO		TI94011798	
1200-Rev.3	19:18090	OSTI; NTIS; INIS; GPO		TI94010886	
1416	19:18588	OSTI; NTIS; INIS		TI94011611	
1475	19:20564	OSTI; NTIS; INIS; GPO		TI94010680	
NUREG/CP–					
0127	19:18798	OSTI; NTIS; INIS; GPO		TI94009269	
0133-Vol.3	19:18488	OSTI; NTIS; INIS; GPO		TI94010683	
0136	19:18799	OSTI; NTIS; INIS		TI94009957	
NUREG/CR–					
4599-Vol.3-No.2	19:18589	OSTI; NTIS; INIS; GPO		TI94008267	
5904	19:18800	OSTI; NTIS; INIS; GPO		TI94011799	
5985	19:18590	OSTI; NTIS; INIS		TI94010311	
6054	19:18515	OSTI; NTIS; GPO; INIS		TI94012121	
6070	19:18091	OSTI; NTIS; INIS; GPO		TI94011608	
6123	19:18577	OSTI; NTIS; INIS; GPO		TI94008691	
6160	19:18516	OSTI; NTIS; INIS; GPO		TI94011196	
6196	19:18517	OSTI; NTIS; INIS; GPO		TI94010313	
6200	19:18489	OSTI; NTIS; INIS; GPO		TI94010312	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
NUTEK-AVF–					
94-1	19:18323	OSTI; NTIS		DE94763349	
NUTEK-B–					
94-1	19:18865	OSTI; NTIS		DE94763352	
NUTEK-TB–					
94-1-N	19:19015	OSTI; NTIS		DE94763357	
94-1-S	19:18893	OSTI; NTIS		DE94763359	
94-1-T	19:18894	OSTI; NTIS		DE94763360	
94-1O	19:18329	OSTI; NTIS; INIS		DE94763358	
NYU-Th–					
93/12/01	19:19998	*See* DESY–93-194			
OCDO–					
94010904	19:17855	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI94010904	
94010905	19:17856	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI94010905	
94010906	19:17857	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI94010906	
94010907	19:17858	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI94010907	
OCS/MMS–					
93-0066	19:18883	OSTI; Department of the Interior, Minerals Management Service, Technical Communications Service, 381 Elden Street, MS 4530, Herndon, VA 22070-4817		TI94011905	
ORNL–					
6797	19:18923	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010813	MF-350
ORNL/CDIAC–					
64	19:19549	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011465	MF-402
ORNL/CON–					
329	19:18924	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010399	MF-350
374	19:18321	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011602	MF-247
383	19:18992	*See* LBL–35376			
384	19:18890	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010517	MF-220
ORNL/ER–					
173	19:18231	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009445	MF-902
199	19:18092	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010812	MF-902
ORNL/FTR–					
4829	19:19781	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94003554	MF-408
4878	19:20456	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008237	MF-420
4894	19:18879	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94005939	MF-400
4895	19:20565	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94006519	MF-405
4897	19:18891	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007216	MF-400
4901	19:18959	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007405	MF-900
4902	19:18591	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007407	
4903	19:20457	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007217	MF-420
4906	19:18925	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007406	MF-350
4910	19:18592	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007537	
4912	19:19496	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008510	MF-406
4913	19:20458	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94007910	MF-420
4917	19:20100	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008511	MF-410
4921	19:18093	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94008749	MF-940
4924	19:18801	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009565	
4925	19:19550	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009524	MF-402
4926	19:20101	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009394	MF-413
4928	19:19894	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009158	MF-408
4929	19:19153	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009737	MF-404
4930	19:20566	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009526	MF-420
4931	19:20459	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009566	MF-423
4935	19:20460	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009857	MF-420
4938	19:17945	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009738	MF-600
ORNL/M–					
2751/ES	19:18094	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016143	MF-902
2751/I	19:18095	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009871	MF-902
2751/V1/Pt.A	19:18096	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016144	MF-902
2751/V1/Pt.C	19:18097	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93016146	MF-902
2751/V2/Pt.A	19:18098	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016147	MF-902

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ORNL/M–					
2751/V2/Pt.C	19:18232	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016149	MF-902
3181	19:18029	*See* DOE/MWIP–14			
3199	19:18099	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011601	MF-902
3271/R1	19:18851	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011610	MF-630
ORNL/RASA–					
93/5	19:18233	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006186	MF-902
ORNL/Sub–					
89-SB482C/02	19:17822	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011725	MF-114
90-99732/2	19:18303	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006309	MF-248
90-SF521/02	19:19046	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010881	MF-114
ORNL/TM–					
11358	19:19608	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011606	MF-902
11792	19:17949	OSTI; NTIS; GPO Dep.	E 1.99:	DE92004886	MF-501
12150	19:19609	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011603	MF-402
12164	19:18800	*See* NUREG/CR–5904			
12351	19:19895	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006113	MF-407
12398	19:18802	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011051	MF-413
12401	19:18234	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005329	MF-902
12475	19:18235	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006502	MF-507
12620	19:19610	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011600	MF-402
12641	19:18521	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011599	MF-522
12650	19:19551	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006501	MF-402
12666	19:19921	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011604	MF-405
12680	19:20567	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010307	MF-405
12707	19:19782	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011796	MF-408
12715	19:18100	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010930	MF-902
12718	19:19231	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010154	MF-506
PATENTS-US–					
A7811215	19:17823	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005161	MF-109
A7821653	19:18101	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007357	MF-721
A7839540	19:19660	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007346	MF-702; MF-706
A7841108	19:19611	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007344	MF-902
A7856427	19:20298	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010171	MF-706
A7858457	19:19503	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010170	MF-706
A7860391	19:20568	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010167	MF-706
A7860617	19:19783	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010166	MF-706
A7860964	19:19514	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010165	MF-706
A7868143	19:18236	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010156	MF-706
A7868149	19:19497	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010137	MF-506
A7874890	19:19154	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010142	MF-704
PB–					
92-100197	19:18624	*See* DOE/ER/30169–T1			
PETC–					
47-93	19:17782	*See* DOE/PC/90051–T12			
PNL–					
8008	19:18102	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001554	MF-940
8221-Rev.1	19:19661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004223	MF-903
8497	19:18515	*See* NUREG/CR–6054			
8564	19:18577	*See* NUREG/CR–6123			
8643	19:18103	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001004	MF-721
8813	19:18104	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001549	MF-902
8830	19:18188	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002708	MF-902
8841	19:18105	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001085	MF-902
8846	19:18106	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009006	MF-602
8862	19:18237	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005647	MF-702
8869	19:19612	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001678	MF-903
8871	19:18107	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001555	MF-940
8893	19:19613	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94002435	
8904	19:18108	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004220	MF-902
8907	19:18238	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003237	MF-902
8919	19:18590	*See* NUREG/CR–5985			
8934	19:18239	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007087	MF-502
8949	19:18240	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004375	MF-903
8969-Vol.3	19:18926	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011220	MF-250
8971	19:19614	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005497	MF-903
8989	19:18241	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005498	MF-630
8991	19:19615	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005295	MF-903
9008	19:19616	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005702	
9012	19:19552	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007089	
9050	19:20569	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010846	MF-705

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
9056	19:19662	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006447	
9060	19:18348	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006432	MF-902
9063	19:18109	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008964	MF-510
9215	19:18189	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010847	MF-902
9341	19:18927	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010752	
9367	19:19896	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009460	MF-603
9380	19:19617	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010671	MF-600
9394	19:19618	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009009	MF-600
9403	19:18110	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010753	MF-601
9410	19:18866	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011221	MF-400
9434	19:18242	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94012120	MF-940
9437	19:19619	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009877	MF-403
9439	19:19232	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010670	MF-906
9443	19:18976	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012119	MF-350
9448	19:19620	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011435	
9457	19:19047	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011607	MF-804
9464	19:19621	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011136	
9465	19:19622	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011137	
PNL-SA–					
16357-Rev.2	19:19791	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011440	MF-408
17044-Rev.1	19:19803	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011676	MF-408
21763	19:19623	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004319	MF-901; MF-903
22235	19:19076	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004765	MF-114
22430	19:20605	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011238	MF-902
22457	19:19048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009881	MF-423
22773	19:19553	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007480	MF-402
22809	19:18111	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004775	MF-502; MF-512
22853	19:18467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004783	MF-502
22883	19:18812	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008047	MF-506
22895	19:18112	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004590	MF-510
22898	19:20461	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004372	MF-504
22899	19:19554	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007476	MF-402
22948	19:18113	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008048	MF-510
22964	19:19688	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004285	MF-408
23046	19:20570	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007477	MF-402; MF-405
23094	19:19474	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007475	MF-704
23096	19:19475	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007474	MF-704
23105	19:19555	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007478	MF-402; MF-406
23160	19:19897	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004778	MF-408
23162	19:19556	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007473	MF-402
23164	19:19557	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003699	MF-902
23181	19:18114	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008733	MF-902
23289	19:19558	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004782	MF-502
23357	19:18115	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004600	MF-940
23405	19:19559	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011441	MF-402
23484	19:19560	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011235	MF-403
23624	19:20571	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006526	MF-500
23708	19:19561	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007491	MF-900
23733	19:19804	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011679	MF-408
23734	19:19805	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011678	MF-508
23750	19:19806	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010707	MF-408
23880	19:18928	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011237	
23976	19:19784	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011192	MF-408
23995	19:19910	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011239	MF-900
24063	19:19562	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011442	MF-402
PNRI-F(PR)–					
94001	19:20497	OSTI; NTIS (US Sales Only); INIS		DE94623845	
PNWD–					
2227-HEDR	19:19663	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011240	
2228-HEDR	19:19563	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011241	
PPPL–					
2958	19:20462	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011545	PC-425
2980	19:20417	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010362	PC-427
2984	19:20418	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010361	PC-427
2986	19:20419	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010360	PC-427
2987	19:20463	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010359	PC-420; PC-421

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PSC–					
30	19:20420	OSTI; NTIS; INIS		DE94765440	
31	19:20421	OSTI; NTIS; INIS		DE94765441	
32	19:20422	OSTI; NTIS; INIS		DE94765447	
PSI-PR–					
93-23	19:20025	*See* DESY–93-179			
PTB-Ra–					
33	19:19476	OSTI; NTIS (US Sales Only); INIS		DE94765929	
34	19:19564	OSTI; NTIS (US Sales Only); INIS		DE94765928	
RCNP-P–					
122	19:20011	OSTI; NTIS; INIS		DE94765593	
123	19:20053	OSTI; NTIS; INIS		DE94765592	
RDA-TR–					
1910001-002	19:19943	*See* UCRL-CR–116204			
RERF-TR–					
14-92	19:19899	OSTI; NTIS; INIS		DE94765436	
9-92	19:19898	OSTI; NTIS; INIS		DE94765439	
RFP–					
4758	19:18116	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006184	MF-721
4795	19:20498	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009880	MF-721
4799	19:18243	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006036	MF-707
4806	19:18117	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006193	MF-630
4807	19:18118	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006473	MF-721
4812	19:19624	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007067	MF-702
4829	19:17991	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009607	MF-700
4835	19:18119	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009983	MF-700
4849	19:19565	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011402	MF-702; MF-707
RFP-ADD–					
0029	19:18120	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010304	MF-630
RISO-HOT-DECOM-P–					
7	19:19233	OSTI; NTIS; INIS		DE94624641	
RISO-R–					
622(EN)	19:19625	OSTI; NTIS; INIS		DE94624248	
694(EN)	19:18886	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763263	
702(EN)	19:18414	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763264	
710(DA)	19:20299	OSTI; NTIS; INIS		DE94625102	
715(EN)	19:20499	OSTI; NTIS; INIS		DE94624815	
716(EN)	19:19626	OSTI; NTIS; INIS		DE94624249	
720(EN)	19:17824	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763265	
723(EN)	19:18317	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763266	
724(EN)	19:18867	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763267	
725(EN)	19:20237	OSTI; NTIS; INIS		DE94625075	
727(EN)	19:18418	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763268	
731(EN)	19:18852	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763269	
732(EN)	19:18828	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763270	
736(EN)	19:17900	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763271	
737(DA)	19:18419	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE94763272	
SAND–					
91-2089	19:18803	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007024	
91-8010/1	19:19510	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008232	MF-700
92-0119	19:18121	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011000	MF-814
92-2016C	19:19504	OSTI; NTIS; GPO Dep.	E 1.99:	DE94003097	MF-741
93-0688	19:18535	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94010306	MF-1030
93-1833C	19:18490	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010802	
93-1922	19:20464	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011244	MF-420
93-2048C	19:19104	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010081	MF-704
93-2070C	19:19155	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010381	MF-704
93-2172C	19:20572	OSTI; NTIS; GPO Dep.	E 1.99:	DE94001422	MF-705
93-2198C	19:20465	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010755	MF-712

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93-2200C	19:18804	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007269	MF-542
93-2240C	19:18122	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006583	MF-702; MF-721
93-2289C	19:18831	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010080	MF-700
93-2510C	19:19301	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010392	MF-704
93-2546C	19:19077	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010086	MF-404
93-2547C	19:19078	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010087	MF-404
93-2554-Vol.1	19:19900	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010673	MF-713
93-2554-Vol.2	19:18299	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010672	MF-713
93-2615C	19:17825	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005283	MF-108
93-2617C	19:19302	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010070	MF-704
93-2645C	19:19234	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010391	MF-700
93-2711C	19:19049	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011329	MF-404
93-2732C	19:19505	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010076	MF-704
93-2765	19:19627	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011245	MF-902
93-2778C	19:19303	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010748	MF-706
93-2785C	19:18826	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011327	MF-706
93-3836	19:19304	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010321	MF-706
93-3862C	19:19050	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010075	MF-706
93-3884	19:18868	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010674	MF-902
93-3894C	19:19235	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005582	
93-3897	19:20606	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011406	MF-705
93-3919	19:19506	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009254	MF-742
93-3957	19:20225	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011744	MF-713
93-7040	19:19156	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011247	MF-903; MF-940
93-7045	19:18491	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010324	MF-523
93-7071	19:18492	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011248	MF-523
93-7073	19:19079	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010325	MF-902
94-0022	19:17934	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011743	MF-126
94-0033	19:19105	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011001	MF-701
94-0129	19:19106	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011249	MF-705
94-0138C	19:18123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007290	MF-812
94-0154C	19:19021	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010385	MF-700
94-0202	19:19477	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011002	MF-713
94-0214	19:18244	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011003	MF-906
94-0247C	19:19107	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010379	MF-704
94-0320	19:19284	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012141	MF-700
94-0329C	19:20466	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011437	MF-712
94-0367C	19:19481	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007868	MF-700
94-0376C	19:18805	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007387	MF-523
94-0377C	19:18806	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94008933	MF-523
94-0382C	19:19482	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007863	MF-706
94-0447C	19:19305	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007298	MF-706
94-0448C	19:19483	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007864	MF-706
94-0457C	19:19484	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007292	MF-704
94-0458C	19:19306	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007742	MF-706
94-0459C	19:19307	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007289	
94-0493C	19:19161	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011025	MF-701; MF-704
94-0532C	19:19485	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007270	MF-706
94-0575C	19:19308	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010089	MF-706
94-0577C	19:19489	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010393	MF-706; MF-705
94-0695C	19:19511	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008429	MF-700
94-0698C	19:17989	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010747	MF-940
94-0709C	19:19309	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010078	MF-706
94-0732C	19:19108	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008744	MF-704
94-0742C	19:19236	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008507	MF-704; MF-706
94-0748C	19:19500	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010077	MF-630
94-0776C	19:20300	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008940	MF-704
94-0783C	19:19022	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008937	MF-700
94-0934C	19:20423	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010090	MF-700
94-0949C	19:18387	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010079	MF-253
94-1045C	19:20573	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010746	MF-405
94-1078C	19:18420	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010798	MF-261
94-1213C	19:20574	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011030	MF-705
94-1224C	19:19507	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011420	MF-701
94-1300C	19:20467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011421	MF-420
94-1347C	19:20575	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011417	MF-705

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94-8219B	19:19109	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012139	MF-704
94-8480	19:17901	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006396	MF-400
94-8481	19:17842	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006394	MF-400
94-8482	19:18318	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006393	MF-400
94-8483C	19:19175	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004340	MF-401
94-8484C	19:19176	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004341	MF-362
94-8485	19:17902	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006395	MF-400
94-8493C	19:19177	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005104	MF-401
94-8510C	19:19178	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005107	MF-401
94-8597	19:19566	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011754	ND-402
94-8645	19:20576	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011751	MF-705
94-8646	19:20577	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011752	MF-705
SEASF-TR–					
90-009	19:18229	*See* LA-SUB–93-306			
SEI-EED–					
24	19:18304	OSTI; NTIS		DE94763361	
26	19:18895	OSTI; NTIS		DE94763362	
27	19:18896	OSTI; NTIS		DE94763363	
SIP–					
0049.	19:20302	*See* CNIC–00655			
0051.	19:20303	*See* CNIC–00659			
0054.	19:20304	*See* CNIC–00679			
0055.	19:20510	*See* CNIC–00689			
0056.	19:20305	*See* CNIC–00691			
0057.	19:19438	*See* CNIC–00709			
SKB-TR–					
92-39	19:18124	OSTI; NTIS; INIS		DE94624777	
93-23	19:18125	OSTI; NTIS; INIS		DE94624774	
93-25	19:18126	OSTI; NTIS; INIS		DE94624778	
SLAC–					
432-Rev.	19:19400	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011142	PC-414
439	19:20054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011141	PC-414
SLAC-PUB–					
6342	19:19401	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010662	MF-414
6448	19:19339	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010320	MF-414
6450	19:20012	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010663	MF-414
6458	19:19429	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010309	MF-414
6470	19:20055	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010751	MF-414
SLAC/SSRL–					
0055(8/93)	19:19401	*See* SLAC-PUB–6342			
SLU-LT-R–					
153	19:19015	*See* NUTEK-TB–94-1-N			
159	19:18329	*See* NUTEK-TB–94-1O			
174	19:18893	*See* NUTEK-TB–94-1-S			
175	19:18894	*See* NUTEK-TB–94-1-T			
SMC–					
0088.	19:19837	*See* CNIC–00693			
0091.	19:19838	*See* CNIC–00712			
0092.	19:19839	*See* CNIC–00716			
SOL–					
93-7	19:20578	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007384	MF-405
SR/H–					
694	19:19051	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE94009156	MF-700
697	19:18283	*See* DPN–130			
698	19:18284	*See* DPN–131			
700	19:18285	*See* DPN–133			
706	19:18645	*See* DPW–55-108			
707	19:17953	*See* DPW–55-104			
709	19:18644	*See* DPW–54-688			
710	19:18643	*See* DPW–54-19-4			
712	19:18646	*See* DPW–55-154			
SRIMT–					
0006.	19:19113	*See* CNIC–00713			
SRO–					
819-24	19:18190	OSTI; NTIS; GPO Dep.	E 1.99:	DE94002812	MF-702
SRO-NERP–					
22	19:19664	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010201	MF-708
SRT-CMA–					
940005	19:19237	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010155	MF-714; MF-722

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SRT-MTS–					
945052	19:18593	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011672	MF-706
SSCL–					
597-Rev.1	19:20013	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010838	MF-414
659	19:19340	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010839	MF-414
660	19:19402	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010840	MF-414
661	19:19341	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011618	MF-414
662	19:19403	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010841	MF-414
663	19:19326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010842	MF-414
664	19:19404	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010843	MF-414
665	19:19405	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011619	MF-414
666	19:19406	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010844	MF-414
667	19:19407	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011620	MF-414
668	19:19408	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011621	MF-414
SSCL-Preprint–					
517-Rev.2	19:19409	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011612	MF-414
538	19:19327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011614	MF-414
SSCL-SR–					
1233	19:19628	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010845	MF-403
1238	19:19410	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011617	MF-414
SSI–					
93-30	19:18635	OSTI; NTIS; INIS		DE94624376	
93-33	19:19629	OSTI; NTIS; INIS		DE94624250	
94-01	19:20500	OSTI; NTIS; INIS		DE94624816	
STUK-A–					
112	19:19665	OSTI; NTIS; INIS		DE94624273	
113	19:18636	OSTI; NTIS; INIS		DE94624380	
96	19:19901	OSTI; NTIS; INIS		DE94624404	
STUK-B-YTO–					
112	19:18493	OSTI; NTIS; INIS		DE94624679	
STUK-YTO-TR–					
38	19:18274	OSTI; NTIS; INIS		DE94624801	
56	19:18275	OSTI; NTIS; INIS		DE94624802	
61	19:18480	OSTI; NTIS; INIS		DE94624678	
62	19:18518	OSTI; NTIS; INIS		DE94624689	
63	19:19052	OSTI; NTIS; INIS		DE94624157	
65	19:19807	OSTI; NTIS; INIS		DE94624374	
TFB–					
93-11	19:18853	OSTI; NTIS		DE94763345	
TKK-KO/ET–					
59	19:18985	OSTI; NTIS		DE94763303	
TKK-MAK/MML–					
1993/3	19:18986	OSTI; NTIS		DE94763315	
TKK-S/SLV–					
10	19:18929	OSTI; NTIS		DE94763321	
14	19:18930	OSTI; NTIS		DE94763304	
TPS–					
93-31	19:19179	OSTI; NTIS		DE94763346	
TRITA-ALF–					
93-06	19:20424	OSTI; NTIS; INIS		DE94625058	
93-07	19:20468	OSTI; NTIS; INIS		DE94625072	
93-08	19:20425	OSTI; NTIS; INIS		DE94625038	
TRITA-MEK–					
93-15	19:19180	OSTI; NTIS		DE94763348	
TSHUNE–					
0003.	19:19254	*See* CNIC–00127			
TTP–					
93-35	19:20060	*See* DESY–93-162			
TURKU-SFL–					
D1	19:18909	OSTI; NTIS		DE94763308	
UCB-PTH–					
93/35	19:19929	*See* LBL–34942			
UCID–					
20622-93-2	19:19111	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011631	MF-701
UCRL–					
52000-94-3	19:19515	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010367	PC-700
UCRL-CR–					
115037	19:18127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004353	MF-603
115295	19:19490	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010896	MF-900
115946	19:19491	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010063	MF-706
116204	19:19943	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010404	MF-700

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116329	19:19478	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009905	MF-700
116511-94-1	19:18807	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009377	MF-407
UCRL-ID–					
111623	19:19630	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009974	MF-902
111728	19:18128	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009975	MF-902
111776	19:18129	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011630	MF-702
113852	19:19631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010000	MF-902
114739	19:18130	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007845	MF-814
114780	19:18276	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007097	MF-900
114802-Rev.1	19:19785	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005686	MF-908
115058	19:19238	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011629	MF-702
115373	19:18245	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007758	MF-903
115726	19:19053	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010357	MF-704
115730	19:19944	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010668	MF-705
115788	19:18131	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007759	MF-702
115831	19:18987	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006624	MF-702
116188	19:18132	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008278	MF-721
116219	19:17950	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010358	MF-700
116533	19:19567	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011628	MF-402
116779	19:20469	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011642	MF-712
116834	19:19010	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010834	MF-333
116958	19:20226	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010667	MF-705
116983	19:20470	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011646	MF-712
117010	19:19017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009977	MF-523
117135	19:20471	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010669	MF-706
117149	19:19516	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010833	MF-700
117158	19:19054	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012118	MF-704
UCRL-JC–					
107799	19:20472	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010894	MF-712
113583-Rev.1	19:19568	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010794	MF-900
113899	19:20579	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010793	MF-905
114201-Rev.1	19:19508	OSTI; NTIS; GPO Dep.	E 1.99:	DE94012237	MF-741
114300	19:20580	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010206	MF-705
114456	19:20426	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010891	MF-712
114854	19:19517	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010056	MF-900
114882	19:19512	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009920	MF-700
114963	19:20473	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010407	MF-712
115251	19:19501	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009912	MF-700
115308	19:19569	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004210	MF-402
115362	19:19632	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006722	MF-902
115654	19:19570	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006474	MF-702
115690	19:19509	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010068	MF-900
115724	19:18133	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007070	MF-940
115798	19:18134	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006658	MF-814
115802	19:19157	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006392	MF-701
115803	19:17944	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008218	MF-361
115804	19:19006	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006405	
115807	19:19181	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008288	MF-700
115857	19:19055	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010207	MF-704
115897	19:19285	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010101	MF-705
115914	19:19502	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010067	MF-900
115945	19:19310	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010409	MF-712
115980	19:19080	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010057	MF-700
116038	19:18808	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009103	
116056	19:17951	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010408	MF-712
116078	19:19311	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010059	MF-706
116132	19:18135	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011740	MF-904; MF-940
116144	19:19633	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006720	MF-902
116184	19:20427	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011645	MF-712
116292-Rev.1	19:19312	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010055	MF-706
116305	19:19239	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008793	MF-610
116324	19:19313	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007075	MF-706
116348	19:19912	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008287	MF-703
116485	19:19571	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009380	MF-702
116505	19:19492	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009384	MF-903
116526	19:19572	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011758	MF-402
116866	19:19945	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009919	MF-700
116931	19:19493	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009916	MF-900
116932	19:19240	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009907	MF-700
116941	19:19946	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010897	MF-700

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116948	19:19241	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009914	MF-722
117000	19:19314	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011643	MF-706
UCRL-LR–					
105821-94-1	19:20474	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010835	PC-712
115294	19:19513	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010364	PC-742
UCRL-MA–					
115696	19:20581	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010066	MF-700
115896	19:20582	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011916	MF-905
USTUR–					
0001-93	19:19902	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004393	MF-607
0002-93	19:19903	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004394	MF-607
VF-UB–					
93-13	19:18331	OSTI; NTIS; INIS		DE94763364	
93-15	19:18324	OSTI; NTIS		DE94763365	
93-16	19:18898	OSTI; NTIS		DE94763366	
93-17	19:18305	OSTI; NTIS		DE94763367	
93-18	19:18330	OSTI; NTIS; INIS		DE94763368	
93-19	19:18322	OSTI; NTIS; INIS		DE94763369	
93-20	19:18869	OSTI; NTIS		DE94763370	
93-21	19:18325	OSTI; NTIS		DE94763371	
93-22	19:18326	OSTI; NTIS		DE94763372	
93-23	19:18306	OSTI; NTIS		DE94763373	
93-24	19:18327	OSTI; NTIS		DE94763374	
93-25	19:18328	OSTI; NTIS		DE94763375	
VTT-ETRR–					
26	19:18931	OSTI; NTIS		DE94763294	
28	19:18932	OSTI; NTIS		DE94763295	
VTT-PUB–					
159	19:17903	OSTI; NTIS		DE94763311	
162	19:18935	OSTI; NTIS		DE94763319	
57	19:18823	OSTI; NTIS		DE94763302	
VTT-SYMP–					
139	19:18936	OSTI; NTIS		DE94763318	
VTT-TIED–					
1425	19:19479	OSTI; NTIS; INIS		DE94624720	
1447	19:18572	OSTI; NTIS; INIS		DE94624796	
1464	19:18594	OSTI; NTIS; INIS		DE94624668	
1502	19:19480	OSTI; NTIS; INIS		DE94624721	
VTT/LVIS2000–					
15	19:18933	OSTI; NTIS		DE94763324	
WAPD-T–					
3030	19:18583	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010809	MF-506
WHC-EP–					
0182-69	19:18136	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011395	MF-940
0436-Rev.1	19:18137	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011394	MF-940
0474-12	19:18246	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011390	MF-900
0619-Vol.1	19:18247	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009389	MF-940
0619-Vol.4	19:18248	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009390	MF-940
0680	19:17967	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005513	MF-940
0696	19:18138	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005504	MF-600
0728	19:18139	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005976	MF-940
0733	19:18140	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009753	MF-902
0734-Rev.1	19:18141	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011393	MF-940
0749	19:19904	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010889	MF-907
0757	19:18249	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010887	MF-940
WHC-MR–					
0289-Rev.3	19:18142	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009388	MF-907
0293-Rev.2	19:18250	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010377	MF-900
0456	19:18143	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010355	MF-902
WHC-SA–					
0896-S	19:18625	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007713	MF-528
0907-S	19:18554	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007703	MF-528
0912-S	19:18555	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007705	MF-528
0913-S	19:18556	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007704	MF-528
0917-S	19:18557	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007709	MF-528
1332-S	19:18809	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007710	MF-528
1347-S	19:18558	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007707	MF-528
1348-S	19:18559	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007708	MF-528
1979	19:18251	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94003849	MF-940
1982	19:18144	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011388	MF-940; MF-902

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1983	19:18145	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011389	MF-940; MF-902
1989	19:19666	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009613	MF-902
2007	19:19242	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009763	MF-714
2033	19:18146	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94002411	MF-940
2086	19:20583	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011449	MF-605
2094	19:18147	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011444	MF-940
2100	19:18148	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009386	MF-940
2102	19:18149	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010348	MF-907; MF-940; MF-902
2112	19:18150	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010374	MF-900
2118	19:18151	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009663	MF-906; MF-940
2123	19:18152	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009437	MF-940
2124	19:18153	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010343	MF-940
2129	19:18154	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010347	MF-940
2130	19:18252	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010349	MF-902; MF-940
2131	19:18155	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005967	MF-940
2133	19:18880	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009288	MF-900
2143	19:18156	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011445	MF-940
2152	19:18157	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010342	MF-940
2159	19:18158	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009765	MF-940; MF-902
2182	19:18832	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011333	MF-900
2264	19:18253	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009662	MF-902; MF-940
2269	19:19573	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010346	MF-902; MF-940
2288	19:18254	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009433	MF-900
2300	19:18159	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011448	MF-940
2333	19:18494	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010375	MF-610
2336	19:17963	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010376	MF-906
2341	19:19243	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009439	MF-940
2345	19:18255	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011396	MF-900
2372	19:18256	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010350	MF-902; MF-940
WHC-SD-EN-AP–					
157	19:18160	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010356	MF-902
WHC-SD-EN-TI–					
197	19:18161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006329	MF-902
214	19:18257	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010371	MF-902
216	19:19634	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006993	MF-902
218	19:19635	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009664	MF-902
WHC-SD-EN-TP–					
031	19:19636	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010378	MF-902
WHC-SD-NR-PHA–					
002	19:18258	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009627	MF-900
WHC-SD-W100-TP–					
002	19:18162	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009385	MF-902
WHC-SD-WM-SARR–					
001	19:18163	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011592	MF-902
WHC-SP–					
0331-Rev.1	19:18164	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011457	MF-700
1033	19:18165	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007986	MF-902; MF-940
WINCO–					
1201	19:18259	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009471	MF-902
WSRC-IM–					
93-017-16	19:18856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010009	MF-702
93-17-5	19:18854	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010007	MF-702
93-17-14	19:18855	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010008	MF-702
WSRC-MS–					
93-198	19:18166	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94001818	MF-721
93-277-Rev.1	19:18260	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007182	MF-707
93-282	19:20475	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009054	MF-700; MF-706
93-421	19:19637	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007196	MF-721
93-456	19:18191	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007284	MF-702
93-474-Rev.1	19:18261	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006648	MF-707; MF-721

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93-485	19:18167	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94005944	MF-721
93-502	19:19574	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004041	MF-402; MF-406
93-551-Rev.1	19:19110	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004432	MF-702; MF-721
93-562	19:18168	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007967	MF-721
93-563	19:18169	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94007279	MF-721
93-615	19:18262	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006387	MF-702
94-0131	19:18810	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008639	MF-706
94-0199	19:19244	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009276	MF-706
94-064	19:19638	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008277	MF-702
94-082	19:19639	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007288	MF-902
WSRC-OS–					
93-16	19:18637	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010830	MF-703
WSRC-RD–					
92-07-Rev.2	19:18170	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004034	MF-721
WSRC-RP–					
93-1388	19:18171	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004029	MF-702
93-1545	19:19640	OSTI; NTIS; GPO Dep.	E 1.99:	DE94007190	MF-702
93-580	19:18192	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004425	MF-702
94-197	19:18172	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011686	MF-721
WSRC-TR–					
92-372	19:20227	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010821	MF-705
93-169-Rev.2	19:18173	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010829	MF-721
93-392	19:19641	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004015	MF-702
93-399	19:19642	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004420	MF-702
93-400	19:19643	OSTI; NTIS; GPO Dep.	E 1.99:	DE94004422	MF-702
93-511	19:19291	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004439	MF-702
93-527	19:18174	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006644	MF-721
93-543	19:18638	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94004017	MF-702
93-565	19:19644	OSTI; NTIS; GPO Dep.	E 1.99:	DE94006668	MF-902
93-575	19:19645	OSTI; NTIS; GPO Dep.	E 1.99:	DE94005140	MF-702
93-656	19:19667	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011167	MF-702
93-671	19:19646	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94006386	MF-702
93-673	19:18175	OSTI; NTIS; GPO Dep.	E 1.99:	DE94008274	MF-702
94-005	19:18193	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010761	MF-702
94-006	19:18194	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010762	MF-702
94-007	19:18195	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010763	MF-702
94-0091	19:18176	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009111	MF-721
94-0126	19:18177	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010823	MF-701
94-0132	19:19158	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011170	MF-701
94-0133	19:19648	OSTI; NTIS; GPO Dep.	E 1.99:	DE94011164	MF-700
94-0155	19:19245	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94009274	MF-706
94-016	19:19647	OSTI; NTIS; GPO Dep.	E 1.99:	DE94009989	MF-702
94-0194	19:18196	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011687	MF-702
94-022	19:20228	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010818	MF-705
94-076	19:19575	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011669	MF-702
94-166	19:18178	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94011689	MF-721
WSS/CI–					
94-015	19:19176	*See* SAND–94-8484C			
WUB–					
93-39	19:20025	*See* DESY–93-179			
94-04	19:20039	*See* DESY–94-011			
Y–					
2464-3	19:17964	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010052	MF-704
2464-7	19:17965	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010049	MF-701
Y/DD–					
613/R1	19:19246	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010046	MF-714
626	19:18811	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010037	MF-714
Y/DV–					
1272	19:19056	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010031	MF-704
Y/EN–					
5214	19:18179	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE94010044	MF-702; MF-707
Y/NA–					
1784	19:19247	OSTI; NTIS; GPO Dep.	E 1.99:	DE94010032	MF-721
YJT–					
87-20-2	19:18519	OSTI; NTIS; INIS		DE94624690	
93-24	19:19668	OSTI; NTIS; INIS		DE94624281	
93-26	19:18180	OSTI; NTIS; INIS		DE94624779	
93-27	19:18181	OSTI; NTIS; INIS		DE94624780	

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93-28	19:18495	OSTI; NTIS; INIS		DE94624680	
93-29	19:19669	OSTI; NTIS; INIS		DE94624282	
93-30	19:20584	OSTI; NTIS; INIS		DE94624808	
94-01	19:19649	OSTI; NTIS; INIS		DE94624251	
ZEUS-Note–					
93-059	19:19473	*See* NIKHEF-H–93-11			

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The correlation list is provided for those organizations that file documents by report number but may receive requests by order number. For more information about a document, refer to the Report Number Index.

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VC Saint Vincent and the Grenadines
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VN Viet Nam
VU Vanuatu

WS Samoa

YE Yemen, Republic of
YU Yugoslavia

ZA South Africa
ZM Zambia
ZR Zaire
ZW Zimbabwe

Codes for International Organizations

ED EANDC [European American Nuclear Data Committee]
EP European Patent Office
IO ILO [International Labor Organization]
IX IUPAC [International Union of Pure and Applied Chemistry]
QS INSPEC [Information Service in Physics, Electrotechnology and Control]
QZ INPADOC [International Patent Document Centre]
WO WIPO [World Intellectual Property Organization]
XA IAEA [International Atomic Energy Agency]
XC CERN [European Organization for Nuclear Research]
XD OECD [Organization for Economic Co-Operation and Development]
XE CEC [Commission of the European Communities]
XF FAO [Food and Agricultural Organization of the United Nations]
XH AAEA [Arab Atomic Energy Agency]
XI IIASA [International Institute for Applied Systems Analysis]
XJ JINR [Joint Institute for Nuclear Research]
XK WMO [World Meteorological Organization]
XN NEA [Nuclear Energy Agency of the OECD]
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XR ICRP [International Commission on Radiological Protection]
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